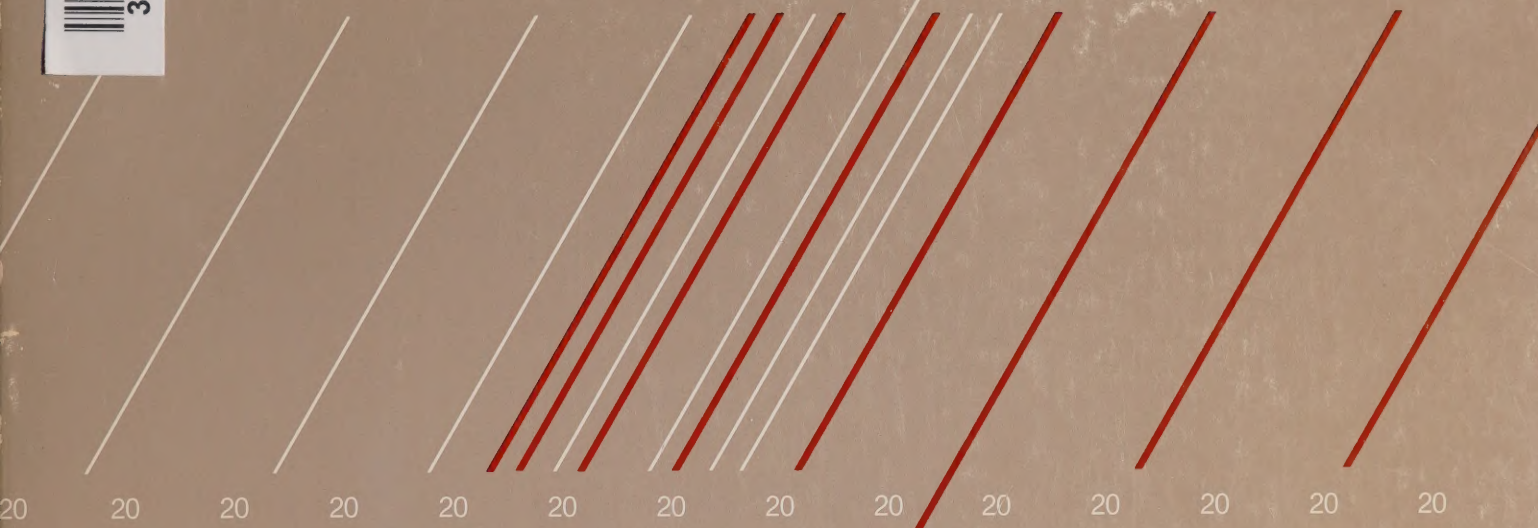
The Ontario Task Force on Employment and New Technology



Technological Change, Productivity and Employment: Macroeconomic Studies

An Appendix to the Final Report

ONTARIO TASK FORCE ON EMPLOYMENT AND NEW TECHNOLOGY

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TECHNOLOGICAL CHANGE, PRODUCTIVITY AND EMPLOYMENT: STUDIES OF THE OVERALL ECONOMY

This Appendix contains reports prepared for the Ontario Task Force on Employment and New Technology. The topic was approved in advance by the Task Force, but the release of the reports does not necessarily imply endorsement of the results by the Task Force or its individual members.

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FOREWORD

The Ontario Task Force on Employment and New Technology, a joint labour-management group, was established in May 1984 "to consider and report on the manpower and employment implications of new technologies as the same may be introduced and applied in Ontario during the next decade and the extent and nature thereof."

To inform its discussions, the Task Force established a research agenda designed to gather information on employment and technological change from a wide variety of sources. The research agenda contained projects which gathered information of a historical nature, and projects with a future orientation which were designed to gather information describing likely occupational and employment implications associated with technological change in the 1985-1995 period.

The Appendices to the Final Report of the Ontario Task Force on Employment and New Technology contain reports of these research projects. A complete list of these Appendices may be found at the rear of this document. This particular appendix examines the technology - employment question in the overall economy as a supplement to studies of particular industries and industry-sectors.

This appendix reports the results of two independently-conducted studies. The first was conducted by Peter Dungan of the Policy Analysis Program of the University of Toronto, and Arthur Younger, Economic Consultant, and is reported in Part I of this appendix. The second study was conducted by Leo de Bever of Chase Econometrics and is reported in Part II of this appendix.

The emphasis in these studies is not to make economic forecasts. Rather, each researcher was requested to determine what the range of possible employment outcomes could be if additional productivity improvements of a given magnitude were to occur in the future.

A commentary on these two studies, prepared by Sam Gindin of United Auto Workers Union, is included in Part III of this appendix.

Dr. Richard L. E. Brown, P.Eng.
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This appendix contains the results of two independent studies, and a commentary by Sam Gindin of United Auto Workers Union.

Professor Dungan would like to acknowledge the valuable contribution of Michael Doucette, in editing and preparation of his paper.

The Task Force would like to thank the authors for their interesting and useful work and comments.

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1.0 INTRODUCTION

There are diametrical, and strongly held views on the evolution of the labour market in the face of shifting technology. To many, it appears that taking prompt advantage of the opportunities offered by radically new techniques of production is the only reliable way to raise average real incomes. New products and production processes allow us to produce more output with the financial and human resources currently available. Producing more with the same input raises everyone's real income and standard of living. Additionally, if other countries embark on a "high technology" strategy we lose ground relative to them if we do not do likewise.[1] Others suggest that the productivity impacts of new technology may create the prospect of technological unemployment by making the skills of many workers permanently obsolete. Returns are increased only to those who happen to have skills which remain in demand. If the increasing capital-intensity of production means that fewer job openings are being created, even with otherwise acceptable economic growth rates, and if the required job skills are not those of much of the current labour force, and if these trends are likely to continue, then a significant portion of today's labour force faces the prospect of enduring "technological unemployment".[2] Eventually, some adjustments must take place, but failing to take advantage of the productive capacity of these workers is a cost which Canadian society cannot and ought not sustain.

In order to provide information useful to this debate, this report describes the results of two related analyses:

- First, by way of background, the report provides an analysis of the historical record of the employment effects of technological change in Canada;

- Second, after reviewing the nature of the relationships between technological change, productivity improvements, and labour

market effects, the report describes a computer-based macro-economic model analysis of the possible magnitude of future employment effects associated with different types of productivity improvement.

More specifically, the second portion of the analysis addresses two principal questions at the level of the national economy.

- What are the aggregate employment implications of different types and faster rates of productivity improvement resulting from the adoption of new technology in Canada over the next decade?

- To what extent are the employment implications of technological change connected with the nature of the change itself, or with other factors in the economic environment in which the change is being introduced? These other factors include wage and price setting and monetary and fiscal policy.

2.0 BACKGROUND: THE HISTORICAL RECORD

2.1 Introduction: The Legacy of the 1970s

For the western industrialized nations the decade of the 1970s was one of great and unexpected economic turbulence. In international finance, the Bretton Woods agreement was abandoned, and most industrial nations adopted floating exchange rates. Successive OPEC crises threw the cost structure of many basic industries into disarray and radically changed the pattern of international trade flows. At the same time that we witnessed the astounding expansion of Japan and South Korea, a mysterious drop in productivity and high interest rates drove growth rates in Europe and North America down to their lowest post-war levels. Finally, the upheaval in energy costs, and the collapse of commodity prices left many Eastern bloc and Third World countries facing severe balance of payments problems, in turn jeopardizing the whole western banking system which, it turned out, was heavily over-exposed in Poland, Mexico, Brazil and Argentina.

Together, these events conspired to lead Canada and the OECD into a catastrophic recession in the early 1980s from which we are scarcely recovering. Growth rates fell rapidly, together with inflation, but at the price of astronomical levels of unemployment. In Canada, for example, the growth of real output dropped from an annual rate of 7 percent in the early 1970s to less than zero, an absolute decline, in 1982. Inflation did indeed fall as a result (and this was the principal goal within the OECD) from over 12 percent in 1981 to 5% in 1983-4, but in 1981-2 alone unemployment skyrocketed by almost 4 percentage points to over 12 percent in aggregate. In the under-25 age bracket it is as much as twice as high. The malaise is more widespread however; the average rate of unemployment in the European economies which are members of the OECD still stands at 10.9 percent, and in most it is rising. Even West Germany, traditionally one of the strongest performers, now sees unemployment over 9 percent despite fairly strong growth of industrial production and relatively low inflation.

Even worse, the prospects for a sustained recovery in the OECD are glum. The strong rebound in the U.S. apparently has not had much effect, other than on the foreign exchange market, anywhere except in Canada. But even in this country where the growth rate has improved by over 2 percent over 1983 and by a total of close to 10 percent over 1982, the rate of unemployment has proven to be quite intractable. Canada is one of the few OECD countries to have experienced a decline in the rate of unemployment by as much as 1 percent in 1983-4. But at that pace, even without further complications, and with continued strong growth of output, it will take until well into the 1990s to achieve a reduction in aggregate unemployment to around the 6.5 percent level.

2.2 The Historical Record: Conflicting Interpretations

What has in fact happened in the Canadian labour market over the past couple of decades? Two points are worth noting. First, since the mid-1960s the rate of unemployment has been following a steady upward trend with only minor interruptions. From 3.4 percent in 1966 unemployment rose to 6.2 percent in 1971-2. It fell in the two ensuing years to 5.3 percent, then rose again steadily for four years reaching 8.3 percent in 1978. A slight improvement followed when it slipped back to 7.5 percent and remained there for three years before skyrocketing to 11 percent in 1982 and 12 percent in 1983. At first glance then, it might be asserted the underlying "natural" definition rate of unemployment (estimated by Dungan and Wilson at 5.5 - 6.5 percent for the 1970s) has continued to rise significantly, since the average rate throughout the decade of the 1960s was less than 4.5 percent. In fact, however, the average rate of unemployment in Canada for the whole post-war period is about 5%. Thus the mid-1960s appear as a happy exception rather than the normal rule.[4]

Second, the share of labour income in GNP has climbed gradually through the 1960s and 1970s from about 51 percent to over 57 percent in the early 1980s, despite some concessionary bargaining in the course of the latest recession. In other words, labour incomes have managed, on average, to stay slightly ahead of inflation not only while employment

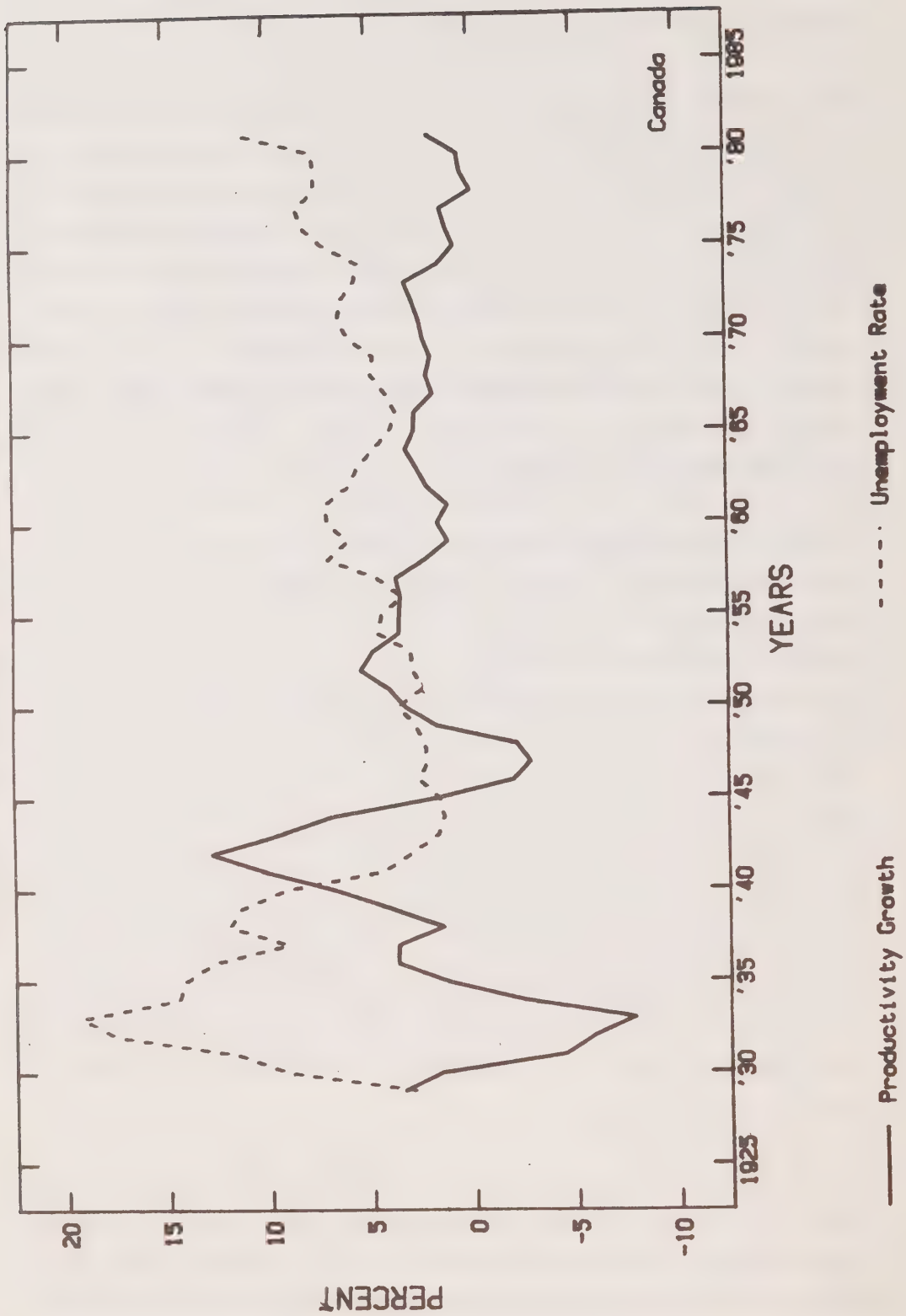
fell but also while labour productivity reached a virtual standstill[5] in the 1970s. It is these two facts together which have a great deal of bearing on the question of the impact of technological change on employment in Canada in the 1980s.

It is worthwhile to examine the combined historical record of unemployment and technological change. Figure 1 shows unemployment and productivity, used as a proxy for technical change, from the 1930s to the present. The data is in the form of three-year moving averages to smooth out minor fluctuations. The record of the last fifty years shows no period of simultaneous high unemployment and high productivity growth. But in the presence of current technology can we reliably predict the opposite, that high productivity growth or technological change will also be unaccompanied by high unemployment? Several economic observations suggest that we can.

Firstly, technological discoveries are not converted into productivity gains immediately. Rather, widespread application must await an economic climate favourable to investment embodying the potential improvements in the form of new capital, or more skilled labour. This was clearly the case with antibiotics, mechanized calculating machines, airplanes and so on which were developed in the 1930s and early 1940s but were not commercialized until after the war. A period of recession, high unemployment and high real interest rates is not conducive to new investment in productivity enhancing technologies. With high unemployment, wage levels are bid up less rapidly. It becomes more profitable to rehire than to invest massively in an untried technology. The risks of new capital investment only decline when labour itself is in relatively scarce supply. This is not to say that labour could not price itself into technological oblivion, but certainly this seems not to have been the case in Canada in the last fifty years.

The "compensation hypothesis", which underlies, and is reaffirmed by a variety of empirical studies of technical change, suggests that while technological change undoubtedly displaces some existing jobs, these are nevertheless more than offset by (i) the growth of demand due to more

FIGURE 1
PRODUCTIVITY GROWTH AND UNEMPLOYMENT RATE



efficient production and (ii) the creation of additional jobs, both in the new industries spawned by the technology itself and in those old industries less directly affected by the technological change. This is the type of result obtained, for example, by Whitely and Wilson[7] whose work with the Cambridge Growth Project Model of the U.K. economy showed a net increase in employment resulting from the application of microelectronic technology in British industry. Experiments in the past, with Canadian models by Chase Econometrics, Informetrica and Younger have yielded similar results.

But the other side of the argument merits consideration: in a recent paper for the OECD[6], Soete and Freeman cast some doubt on the compensation hypothesis. It may suffer, according to Soete and Freeman, from according insufficient weight to time lags in adjustment. These may result in (i) a capital shortage relative to the available labour force and (ii) a mismatch between available and required labour skills. The former may arise for several reasons: a slowdown in investment, a tendency towards investment in plant rationalization, and an acceleration in scrappage rates. According to the authors, there is evidence of a skills mismatch in most OECD countries since the job vacancy rate is high at the same time as there is rising unemployment. Moreover, the microelectronic revolution promises to affect an extremely wide portion of the economy, not only the manufacturing sector but also the service industries which typically comprise at least 50 percent of aggregate activity in an advanced economy. The only point of optimism, for Soete and Freeman, is that microelectronics seems to increase the efficiency of both labour and capital together.

In general, recent empirical studies of technical change in the Canadian economy show a net employment increase after seven to ten years as a result of the compensation mechanism. But is it possible that the modelers are wrong? Or, perhaps more likely, are their models structurally unable to predict the employment effects of a new technology which, by definition did not figure in the data used to build the models themselves?

In a provocative paper[8], Paul Davenport has provided one of the only cogent alternative arguments to the compensation hypothesis based on recent Canadian data. In brief, his procedure involved the estimation of a statistical relationship between the growth of productive capacity, on the one hand, and capacity utilization, the propensity to invest out of income, and the so-called "investment coefficient" on the other. This last term, which is crucial to the argument, refers to the net addition to productive capacity furnished by each new unit of investment. His first set of results are fairly straightforward and show that: while the propensity to invest, and capacity utilization remained relatively constant over the sample period, the net addition to capacity of new investment fell sharply from 1974 onwards, an index of "capital-using" technical change. As a result, productive capacity in Canada has been growing more slowly since the mid-1970s while labour force growth itself had not fallen. Hence, he estimates that the underlying long-run rate of unemployment can be expected to rise by about one percentage point in the 1980s. This analysis suggests the need for a policy to speed up the rate of investment if we are to reduce this unemployment "gap" in the near future, and indeed Davenport himself has drawn this conclusion.[9]

3.0 TECHNOLOGICAL CHANGE AND PRODUCTIVITY IMPROVEMENTS: AN OVERVIEW

3.1 Introduction

For a variety of reasons, technological change, particularly as it affects the labour market, has received little systematic economic analysis until recently. Since the economics of technological change are not generally well understood, we thought it useful to provide an overview of the principal economic issues involved. Our simulations reported in Section Four are designed to provide answers to the research questions posed earlier, but do not claim to test exhaustively all dimensions of the problem. Thus, as we review the principle issues involved, we pay particular attention in this section to those aspects which, although not tested explicitly, will undoubtedly have a material impact on the actual course of events in Canada. In summary, the issues to be covered are as follows:

- three types of productivity improvement,
- the distribution of productivity gains between capital and labour,
- the simultaneous occurrence of different types of change in different sectors of the economy,
- the role of the diffusion process,
- the macroeconomic environment, and
- the effect of international developments.

3.2 Three types of productivity improvement

The first phase of any scientific investigation is taxonomic. Assuming for the moment that goods and services are produced using only two types of economic inputs, and that the share of total income accruing to

labour and capital remains unaltered, or neutral in economists' terms, by the technical advance, one can identify three possible types of productivity improvements. Technological change may be said to save on labour if, as output rises, the ratio of capital to output remains constant while that of labour to output falls. Bear in mind that no absolute decline in employment is implied as long as output rises. Moreover, it would be possible for the real wage to rise. Alternately, were the reverse to be the case, we would be saving on capital. Finally, were these two changes to occur simultaneously, we would note a constant capital to labour ratio over time even as the rate of production rises. If both factors are becoming more efficient at the same rate we refer to this as a "total factor productivity improvement" or a saving in both capital and labour together.

Let us consider an illustrative example. Suppose that the original technology involves men using shovels to dig holes at the rate of one hole per man and shovel per day. An example of "capital saving" technical change would be the following: the first group of workers, recognizing that their shovels are unused at night allow them to be used by a second shift of diggers. Whereas we may suppose that initially ten men and shovels dug ten holes per day, we now have twenty men and ten shovels digging twenty holes per day. The labour/output ratio remains constant while the capital/output ratio falls by half. Returning to the initial situation, an example of "labour saving" technical change might be the following: the men suddenly learn how to use one shovel in each hand so that each is able to double his previous output. Now we have 20 shovels used by ten men to dig twenty holes per day. Finally, a "global productivity enhancement" would require merely using shovels with larger blades so that ten men and shovels now manage to dig better, completing twenty holes per day rather than the original ten while the capital/labour ratio remains constant.

Of course, things are not often so admirably simple. In particular, we have glossed over the <u>cost</u> of replacing one set of capital equipment with another, and in cases in which new operating skills are required there would be a similar labour cost. An extension of our example will

suggest the answer. Suppose it is now a question of buying a bulldozer which, incidentally, any one of the diggers can operate. Many scenarios can be envisaged. Suppose the bulldozer is a thousand times as efficient as a shovel and costs a thousand times as much. Where before we had a thousand men and shovels digging a thousand holes, we now have one $1,000 bulldozer and one man, with same total output as before. In dollar terms, the capital/output ratio is unchanged and it is a case of technical progress which saves on labour. Bear in mind that as long as we retain the assumption of equal income shares, and holes earn one dollar each, the man's wage has risen from $0.50 to $500. Whether the remaining 999 men will be employed or not depends on the demand for holes. And how the economy responds to the extra income created by the use of productivity enhancing technology.

3.3 Distribution of Productivity Gains

In fact, the question which lies at the heart of the debate over technology and employment is: what are the effects of technical change on the distribution of total income? There is concern about the type of technical change only insofar as it affects wage rates and the number of remunerative jobs available. It is this distribution question which has given rise to the many strongly held opinions about the future of work. Several points must be made, roughly in order of complexity: then we will try to illustrate them with the help of our previous example.

- First, if income shares are fixed, there is an unavoidable tradeoff between higher real wages and greater employment on the labour side.

- Second, the "bias" of technological change at a certain time and place is quite independent from the type of technical change in question. Rather, it is largely determined by total demand, labour market behaviour, and other economic factors.

- Third, the question of the ownership of capital becomes important in this regard since there are two potential uses for the new

income deriving from productivity improvements. In a two factor world, if the returns to capital rise, wage earnings (or the rewards for supplying labour) fall. If the individual does both however, his total income is more stable. However, in the long run as the economy grows, the division of the economic pie is no longer a zero sum game.

. Fourth, if technological change involves any productivity improvement whatsoever, the total value of production is higher than it would otherwise have been. In the case of a one-shot technological change, this will sooner or later work its way through the whole economy so that eventually everyone profits. But that takes several years.

. Fifth, for there to be long-run technological unemployment we must presume that a given type of technical change will regularly repeat itself over a long period of time without any significant equilibrating mechanisms serving to redistribute the windfall gains among all the participants. Is this at all likely?

In elaborating somewhat upon these points, let us start by explaining what is sometimes referred to in the economic literature as the "bias" of technical change. Recall that in the previous section we pointed out that there are three types of productivity improvement, and that we cannot tell a priori whether a new piece of capital equipment saves on labour, or capital, or both. These three basic types of change were described and illustrated under the assumption that they had no effect upon the remuneration of the various agents or factors of production as a percent of total income. If we relax the latter assumption we obtain an idea of the bias of technical change. If the share of total income accruing to capital rises and, in a two-factor world, that of labour falls, the change is capital-using. In the opposite case, naturally, it is labour-using. Now, either of these may conceivably occur no matter what the type of technical change in question. One may, for example find labour-saving but capital-using technical progress; and this is clearly desirable under conditions of full employment. Capital-saving and labour-using

progress would be desirable under less than full employment. The terminology is untidy, even for the well-intentioned, so we will have recourse once more to our example.

We may summarize the four cases from our earlier discussion in tabular form.

Men	Shovels	Output/ Income	Total Wages	Wage/ Man	Return to Capital	Return/ Unit Capital
10	10	10	5	0.5	5	0.5
10	20	20	10	1.0	10	0.5
20	10	20	10	0.5	10	1.0
10	10	20	10	1.0	10	1.0

The first case represents the original situation. The second shows labour-saving progress since capital/output remains constant. The third demonstrates capital-saving (a night shift using the same shovels). The fourth shows global saving on both labour and capital with labour/output constant but higher output and wages.

We have assumed earnings of $1 per hole, to be divided equally between the factors. Inspection of Case Two for example, shows that this will result in average returns to each factor which exactly reflect their relative effectiveness in terms of output. The total daily revenue of $20 is divided equally: $10 to capital and $10 to labour. However, since the same number of shovels per hole is required as in Case One, the per unit return to capital is unchanged at $0.50. It is the men who are now more "efficient" and earn twice their previous wage as a result. In practice, however, the distribution of income is not calculated in this way. Wages, in particular, are the subject of negotiation, explicitly or implicitly, and workers usually are not fully informed about their actual efficiency relative to the employer's capital costs and equipment. It is here that the bias of income distribution comes into play.

As we move from Case One to Case Two the wage is set by negotiation. If the agreed wage is less than $1 per man, that is, less than the per unit value of output attributed to labour, then labour is relatively cheaper than capital. In other words, the ratio of wages to return on capital is lower than the ratio of labour output per man to capital output per shovel. In such a case, more labour will be employed than before even though the technological change is, in itself, labour-saving. Conversely, of course, if the wage exceeded $1, less labour would be employed than in Case One.

The important point is that the relative shares of income are set quite independently of the efficiency of the technology. Clearly, many other changes could occur at the same time: the price of holes may fall, the size of the labour force may increase or the intital cost of purchasing capital may change.

3.4 Simultaneity of Different Types of Change

The third issue to be borne in mind will not be treated explicitly in our simulations. It is that different types of technological change may be going on concurrently in different industries within the same economy. For the purpose of addressing this sort of question, we may distinguish between so-called product and process oriented innovations. The former are those which introduce a new type of product to the marketplace such as: the microprocessor or "chip", ceramic engine parts, robotics, or information technology, which may answer to a substantial latent demand either on the part of consumers or other businesses who see how to use the new product in their own operations. The actual use of a new product or method in producing other products is a case of process innovation.

One of the present authors, Younger, has analyzed the simultaneous occurrence of product and process innovation related to microelectronics in Canada. For that study, the empirical data collected showed that the production of microelectronic products themselves was relatively labour-intensive and yielded high average wages. However, the

application of microelectronics in a variety of production settings in other industries was capital-intensive, achieving efficiency gains from the reduction of unit labour inputs and costs. Clearly, the overall effect of these two contradictory tendencies depends on their relative importance. The microelectronic producing sector in Canada is quite small, while the production applications of computerized technologies will touch many of our most important manufacturing and service industries: for example, automobiles, heavy equipment and banking. The result, dependent upon the rate of adoption of the microelectronic technology, would be a period of a technologically-induced reduction in the growth of employment until the overall efficiency gains have fed through the system.

Casual empiricism today would suggest that microelectronics based technology - word processors, instant tellers, robotics, CAD/CAM - will have the uniform effect of displacing labour in a wide range of manufacturing and service industries. In fact, the greatest danger seems to be that, unlike the era of the agricultural revolution or the industrial revolution following it, there is no relatively labour-intensive sector left to take up the slack. The service sector itself may undergo severe realignment. However, the distinction should be made between qualitatively different types of services. Some services, processing routine information or transactions may be relatively easy to automate. Other types of services involve a high degree of human contact, which are fundamental to the quality of the service provided and cannot readily be automated It must not be forgotten, however, that new technologies themselves spawn a host of new industries and support-functions, thus driving industrial development itself, and that it is not a simple matter - as we have shown above - to determine whether a given technology is fundamentally labour-saving or labour-using. In fact, we subscribe to the conclusion of Soete and Freeman who see the newer technologies as saving simultaneously on both capital and labour.

3.5 The Diffusion Process

Much of the public debate over new technologies in Canada has centered on the desirable pace of change. Unfortunately, although various theoretical models of the diffusion process have been proposed, we do not have a firm notion of the microeconomic factors at work. Several points, however, are worth emphasizing. First, there are really four levels of diffusion of technology:

(i) within a single firm, where production processes may be much more sophisticated than sales or administration for instance;

(ii) between firms in a single industry, where the usual argument turns around whether large or small firms innovate more rapidly;

(iii) between industries, where shortages of skilled labour or of a supply of special capital goods may pose impediments; and finally

(iv) between countries, where technological leadership is often the mark of above average growth rates.

In this study our principal focus is on economy-wide diffusion, and we do not attempt to deal with differential rates of innovation in specific industries; that would require more detailed data from sector studies[10]. At the international level, studies such as those by Steve Globerman for the Economic Council of Canada have indicated that Canada may be relatively slow to adopt new technology when compared to the U.S. or Japan.

It has been shown by Stoneman[11] that the rate of diffusion does indeed have a decisive influence on the labour market. Rapid diffusion, coupled with a fixed real wage and imperfect price adjustment, allows new employment created indirectly by new technology to more than outweigh direct job displacement. Indeed, the higher the rate of

diffusion the greater the job creation. But if the wage rate is allowed to rise, with new capital-intensive technology, employment falls. If the technology is relatively labour-intensive, employment rises initially and then falls. Slower diffusion paths ought to yield an entirely different family of results.

We have been able to test the difference between fixed and rising real wages in our simulations, as we shall later report. It must be recalled that macroeconomic policy can be used to alleviate certain adjustment problems, but since that is more likely possible in the relatively short-run, it would be more useful if diffusion is fairly rapid. Two other problems are also important; first, diffusion rates must be measured in the international context, second, the relative absence of domestic supplies of high technology labour and capital could slow the pace of diffusion.

3.6 Macroeconomic Context of Technological Change

If prices adjust instantaneously to reflect the cost savings in production attributable to the use of new technology, the theoretical models suggest that there will be little or no job displacement, even in the short term. It is fair to ask whether there is some set of feasible macroeconomic policies which would yield approximately these results. We have two initial grounds for optimism. First, insofar as there are cost savings in production, inflationary pressures on prices are reduced. But in fact we do not have to rely on the price vehicle. Careful management of the economic environment could permit one to allocate that implicit productivity dividend to other economic goals in the short run, although eventually attaining the same equilibrium position. Society could, for instance, contemplate a higher growth rate at the old rate of inflation, rather than an immediate reduction of price level changes, or alternatively, it could choose to allocate more or less to wages and profits respectively, and so on.

The main determinants of the economic context, of course, are: fiscal, monetary and exchange rate factors, and wage and price factors. The

main fiscal question is whether or not to use the productivity dividend to reduce the deficit, at the expense of overall growth. In earlier work, assuming no action on the deficit, we concentrated on the other two dimensions of the macroeconomic environment and showed that employment growth under new technology is most rapid if the money supply is expanded to offset any exchange rate movement, while real wage demands are limited to let cost savings be passed through quickly into price reductions.[12] Favouring low inflation over renewed growth by means of restrictive monetary growth targets yielded the worst results.

A similar procedure will be followed in the simulations for the present report. We have tested the difference between money supply and exchange rate targets, the effect of restricting real wage gains in the short run and that of a tax cut equal in value to the potential deficit reduction. We find once more evidence of the great importance of wage and price flexibility in ensuring minimal disruption on the labour market, but also that the employment impacts are much more sensitive to the economic environment than to the nature of the technological change underway.

3.7 Importance of International Developments

In concluding this section, one final point should be emphasized. In the following sections we will be talking about the benefits accruing to various parts of the Canadian economy from raising cumulatively the efficiency of production by about one half percent a year. These results, however, assume that nothing is changing in other countries. In other words, we are talking about the benefits achieved if the efficiency of production in Canada exceeds that of the rest of the world. But what if other countries are also actively pursuing technological improvement? In some simulations done in 1981, Chase Econometrics looked at the effect on Canada if both Canadian and U.S. economies achieved identical efficiency gains. Their results showed that there was very little difference from the case in which Canada alone achieved the given productivity improvement. If anything, the reduction in inflation was somewhat greater when both economies improved efficiency. In no

case were employment levels significantly different from their base case. Unfortunately, they did not test the effect of productivity improvement in the U.S. alone. It is reasonable to suppose that it would raise Canadian import levels and reduce our exports, however, thus weakening our overall economic performance.

4.0 PRODUCTIVITY IMPROVEMENT, EMPLOYMENT AND GROWTH: SIMULATION EXPERIMENTS

4.1 Introduction: The Aggregate Economy

This study uses computer simulation techniques to study the impact of possible scenarios of technological change on employment and growth in the Canadian economy. It is sometimes suggested that it is not possible to look at the economy in aggregate because it is so complex, because there are so many different "actors" all engaged in complicated activity. Yet this observation can be turned on its head: it is because the economy is so complex that we must sometimes simplify and work in aggregate. The economy has so much detail that is rarely possible to work "bottom up" to indicators like GNP or the unemployment rate; to do so would demand vast resources. It goes without saying that there is much to be learned from selected sampling of economic detail, but to be able to say something about the impact of technology on indicators like GNP growth and unemployment, some resort must be had to aggregate methods - or little can be said at all.

More importantly, aggregate analysis is not simply a substitute for detailed analysis; it adds an important element on its own since economic analysis suggests that there are factors at work in the economy as a whole which are not apparent in the examination of individual units. It is quite possible for a firm or an industry to close down, for a group of workers or even a whole town to be thrown out of work. But it is much less likely for this to happen to a whole economy, simply because if a whole economy is threatened with low demand and unemployment, then wages, prices, and perhaps the exchange rate and monetary and fiscal mechanisms will all begin to respond. These factors, perhaps very slowly, will tend to push the economy towards less unemployment again. True, the economy may end up being employed at different jobs, and the costs of transition may be high, but there are "equilibrating" forces at work which are not apparent in the examination of single firms or industries. To get a picture of the impact of technology on the economy as a whole, it is not sufficient simply to total up possible job

losses in all industries; we also need some kind of aggregate analysis which takes account of the economy-wide "equilibrating mechanisms" not apparent in detailed studies.

The purpose of this study is to examine the technology-employment question in the aggregate as a supplement to careful analysis of impacts in particular sectors. Its chief contribution will be to remind us of the adjustment mechanisms which will be operating through the economy as a whole if trends toward technological unemployment are indentified in a sufficient number of sectors such that, together, they would have a significant aggregate effect.

Generally speaking there are two basic methods of determining "what would happen" in the real world if certain events were to take place. The first of these is direct, controlled experimentation, but for the economy this method will not work. The only experiment we could perform to determine the economy-wide impacts of improved technology would be actually to engineer the improvement - and even then the evidence might be obscured by other events occurring at the same time (i.e. the experiment could not be controlled).

The second method of investigation is modeling or simulation. Here a model or representation of the real world is constructed, and experiments are performed upon the model. This method is used along with direct experimentation in the hard sciences; for example, models of aircraft are tested in wind tunnels before full prototypes are built. It is effectively the only method available for examining "what would happen if?" questions about the macro-economy.

This study has been conducted using FOCUS, a computer simulation model of the Canadian economy built and maintained at the University of Toronto. The Canadian economy is obviously very complex, and the FOCUS model is only a very simplified representation. Yet, with the power of the computer, it "remembers" economic relationships that are difficult for a single analyst to keep in mind all at once. It also embodies the research experience of a number of University of Toronto

economists through the years about the working of the complex Canadian economy.

Of course, the methods of economic modeling are not completely precise. The model is a simplification and its representation of the economy is inexact. Readers (and the authors) must therefore be wary of attributing too-great a precision to the model results. The experiments reported on here are only intended to indicate the direction and order of magnitude of the possible impacts of technological change on employment.

It should also be noted that the present experiments are not in any way forecasts. Economic forecasting is difficult and there have been some spectacular failures in the past. But usually, when forecasts have erred, it has not been the fault of the model, but rather of the many inputs which must be entered to make a forecast. For example, the depth of the 1982 recession was missed by forecasters in 1980 and 1981 because they did not believe policy makers would stand by and let the recession happen. The present analysis is comparatively much simpler; we are asking "what if?" questions about increased technological improvement and faster productivity growth, in order to determine whether a danger of high unemployment might exist. We are not trying to forecast whether such increased technological improvement will occur, or what the Canadian economy will actually look like with or without it.

4.2 How The Experiments Were Done

The method by which the analysis has been done is simple: First, the FOCUS model has been used to generate a base case projection for the economy over the next decade. The details of this base case are summarized in Appendix B. Its important features are that it continues to show the economy with overall excess capacity over the next decade, although the gap opened in 1982 is gradually closed, and that it embodies a relatively low rate of productivity growth. Next, we enter various alternative productivity improvements into the model and let the model readjust, generating in each case an alternative scenario.

The differences between these alternative scenarios and the base case are then our measures of the direct and indirect impacts of the productivity improvement. It is on these impacts which we will be concentrating.

These simulation experiments address the three major questions raised earlier in the report. Briefly, these questions relate to the nature and extent of the employment aspects of technological change and the sensitivity of these impacts to the overall economic environment in which the technology is being introduced.

Three types of productivity improvements are examined; labour saving, capital saving, and mixed labour and capital productivity improvements - that is - savings in both capital and labour together. Each type of productivity improvement can potentially have a different effect on the economy. In the first set of experiments, described below, we enter each type of productivity improvement separately into the FOCUS model, generating three separate scenarios. Each alternative is compared against the base case, and against each other, initially using a common set of assumptions about the economic environment. In generating these scenarios, it is important to emphasize that the size of the productivity improvements we test are in no way forecasts of what productivity enhancement will or could be achieved, but rather represent judgements on our part of what reasonably may occur. Our intention is to estimate the impact on the rest of the economy of a given level of productivity increase, not to forecast what the improvement will be.

In a second set of experiments, we choose one type of productivity increase, and one set of assumptions about the economic environment, and test the impact of different price and wage responses. Two major questions are examined; first, how the effect of productivity improvements being passed on to consumers through decreases in price levels, and second, how quickly do improvements in productivity get translated into higher real wages. The alternatives examined are extreme cases, and different mixtures of outcomes could be expected.

Finally, we examine the effects of different assumptions about the macroeconomic environment. First, we examine the impact of changes in monetary and exchange rate targets by the Bank of Canada. Second, the impact of changes in regards to total government deficits are examined. For this set of experiments only one type of productivity change and one type of price and wage response are examined. Again, the alternatives examined are extremes to test for sensitivity.

The conclusion summarizes the analysis and compares the range of possible outcomes of higher productivity growth.

4.3 Alternative Types of Productivity Improvement

This section examines the impacts on growth, employment, inflation and other variables of the three possible types of productivity improvement discussed earlier in the report: mixed labour and capital productivity enhancement, capital productivity enhancement, labour productivity enhancement.

Mixed labour and capital productivity enhancement is the customary type used in economic analysis, and a term already exists for the concept in the FOCUS model. To examine the impact of improvement in mixed productivity growth, the base-case growth rate of this term in FOCUS was annually increased by .5 percent for 1985 through 1994. For perspective, an increase of .5 percent would restore somewhat less than half of what this type of productivity growth lost between in the 1960s and the 1970s-early 80s. That is, mixed capital-labour productivity enhancement proceeded at about 1.5 to 2.0 percent per year in the 1960s-early 70s. In the later 70s and early 80s it has fallen to .5 percent per year and below. Results of this experiment are shown in Table A-1.

Enhanced capital productivity must be "embodied" in new capital put in place. To examine the impact of purely capital-enhancing productivity improvement, a second experiment was run in which new capital (put in place in 1985 and after) was assumed to be more effective than that in

the base case. Specifically, the new plant was assumed to be 5 percent more effective and new machinery and equipment 20 percent more effective. Note these adjustments are averages; for machinery and equipment this could translate as one-fifth of new equipment being twice as effective. Results are shown in Table A-2.

Enhanced productivity centered on labour was simulated by making the private-sector labour force more effective than in the base by cumulative 0.5 percent per year. Again, such an increment is well within the historical range for variations in labour effectiveness. Results are presented in Table A-3. Note that the amount of productivity enhancement selected for each experiment is arbitrary; although well within plausible ranges. Each experiment features a "round number" augmentation, and comparing among the experiments requires some judgement.

Each of the three experiments was run with the same set of price, wage and other economic assumptions. Specifically, prices were assumed to be relatively flexible, real wages rise with output per employee although with a lag, and monetary and fiscal factors are unresponsive to productivity growth. Other alternatives will be examined in the following sections, but for now it should be understood that these are slightly pessimistic assumptions. If economic performance and the responses of policy makers and the private sector are more positive, likely outcomes in terms of employment may be quite different.

4.4 Results

Results for the three different types of productivity enhancement are compared in Table 1. From our experiments we found that that the type of productivity enhancement really does not matter much in terms of the relative impacts on growth, inflation and employment.

Note that the labour-only experiment yields smaller results for growth and employment than the other two experiments. This is purely accidental and based on the arbitrary amounts by which productivity was enhanced in each experiment. The results must not be interpreted to

TABLE 1

COMPARISON OF IMPACTS RESULTING FROM ALTERNATE TYPES OF PRODUCTIVITY INCREASES

Assumptions - "Flexible" Price Response
- Real Wage Gains
- Money Growth Target
- No Tax Cuts
- Deficit Reduction Target

IMPACT	1985	1986	1987	1990	1994
Real GNP (% of base)					
Labour/Capital	0.2	0.5	1.0	2.6	4.9
Capital Only	0.3	0.8	1.6	3.5	5.0
Labour Only	0.2	0.4	0.7	1.7	3.1
Employment (% of base)					
Labour/Capital	-0.1	-0.2	-0.3	-0.3	-0.6
Capital Only	-0.1	-0.3	-0.4	-0.4	-0.5
Labour Only	-0.1	-0.1	-0.1	-0.2	-0.4
Inflation (% pts)					
Labour/Capital	-0.6	-1.0	-0.9	-0.8	-0.8
Capital Only	-1.1	-1.5	-1.2	-0.6	-0.3
Labour Only	-0.6	-0.6	-0.5	-0.5	-0.5
Output per Employee (% of base)					
Labour/Capital	0.3	0.8	1.3	3.0	5.4
Capital Only	0.4	1.2	2.0	3.8	5.3
Labour Only	0.3	0.6	0.9	1.9	3.4

NOTES:

Labour/Capital: Labour/Capital Productivity Enhancement (Appendix Table A-1)

Capital Only: Capital Only Enhancement (Appendix Table A-2)

Labour Only: Labour Only Enhancement (Appendix Table A-3)

FINDING:

There are no significant differences in the employment effects of different types of productivity improvements.

mean that labour-only enhancement is somehow less effective. What is important are the ratios of GNP to employment effects, and related measures. As it happens, the jobs lost per unit of GNP gain are about the same for each type of productivity enhancement. There are also about the same proportional effects on inflation and other variables. Note that even output per employee is augmented in about the same proportion to GNP in each experiment.

Why are the results proportionally so similar? This result depends on the FOCUS model's view of the aggregate economy, which is a very mainstream or standard view. In FOCUS labour and capital will be substituted for each other depending on their relative prices. In aggregate such substitutability is seen to be possible. Thus, when productivity is enhanced, no matter what the enhancement's source, total supply tends to increase but the mix of capital and labour used to produce it depends primarily on their relative prices, and these change little. If supply must then be cut back somewhat to meet demand (as in these experiments) then use of both labour and capital is cut back, hence a reduction in employment.

Moreover, real wages will, with a lag of some years, reflect increases in output per employee no matter what the original source of the improvement. There will be a secondary adjustment in employment in response, but again the source of the productivity enhancement matters little since the relative price of labour depends on changes in output per employee no matter what their source.

Of course, other views of the world are possible, and would change the result. If capital and labour are used more in fixed proportions then relative enhancements of one or the other will have different effects on employment. Certainly fixed proportions may well be the case in particular sectors of the economy. But for the economy as a whole, the mainstream view, as embodied in FOCUS, is that the source of productivity enhancement is of relatively little concern compared to the response of aggregate demand or of the relative price of labour.

Other aspects of the results should now be reviewed (see especially Tables 1 and A-1). First, note that productivity enhancement, no matter what the source, slightly reduces employment under the present configuration of price/wage and policy responses. At the same time, almost all other effects are positive: real GNP is increased by many billions of dollars after ten years, inflation and interest rates are down, and so is the government deficit. Real wages per employed person are increased. The balance of payments is also improved. In brief, extra productivity creates extra income, or the potential for extra income, which we call the "productivity dividend". The dividend clearly offers some room to maneuver, especially in terms of policy response, which will be examined further below.

Moreover, the loss of employment is not massive even under the rather severe conditions assumed. Note that the unemployment rate is only a bit over three-tenths of a percent worse in 1994 (Table A-1). Note that the unfavourable impact on the unemployment rate increases over time in the experiments. It must be remembered that the experiment involves an annual increase, for 10 years, in the rate of technological advance; as the economy cannot quite accommodate the increased rate of advance there is a cumulative employment loss. In fact, technological advance is quite as likely to come in spurts which give the economy time to adjust afterwards. Such scenarios can show the unemployment rates first rising and then falling back to base-case levels as the technology spurt is absorbed.[13]

It should also be noted that the experiments generate very little change in income shares. Corporate profits and wages and salaries as a share of GNP move hardly at all; if anything there is a tiny rise in labour's share. There is a more pronounced effect on the make-up on GNP. Note in Table A-1, for 1994, that while GNP is increased by 4.9 percent above base, consumption is 1.0% above base and investment is up by 1.9 percent. That is, most of the additional GNP is not being enjoyed as additional consumption. Proportionally a somewhat greater share is being invested, but much of the additional GNP is either being exported or is replacing imports that would otherwise have occurred. This

improvement in net exports stems from the enhanced Canadian productivity. The balance-of-payments surplus thus generated offers Canadian monetary policy some interesting choices.

From our research we have learned two important lessons: first, and most important, the type of productivity enhancement, whether concentrated on saving labour or capital, or both, matters very little to the outcome for employment. As will be seen below, there are more critical factors. Second, without some sort of price/wage response, or other change in the economic environment, productivity enhancement of the type tried here involves a small job loss.

4.4.1 Alternative Price and Wage Responses:

The previous section found that significant productivity enhancement offers a large potential "productivity dividend" in additional income. The present section examines how the impact of productivity enhancement will vary depending on how labour and management attempt to share out the dividend. Ultimately, this comes down to the question of how prices and wages are set under a rise in productivity.

4.4.2 Corporate Pricing Responses: Effects on Employment

There is an ongoing debate in economics about how prices are set in the economy. Clearly, there are some markets in which prices respond to market pressures of supply or demand very quickly, for example, those for primary commodities traded internationally. There are other markets, such as, those for manufactured goods with few producers, where prices are set by the deliberate decisions of firms; these prices also respond to forces of supply and demand, but the response is much more sluggish and takes longer to occur. The debate concerns how important each type of price-setting is in the economy.

The initial impact of an enhancement of productivity is to increase the supply of output - at least - the supply which firms would like to sell at the "pre-impact" price. Unfortunately, there will probably be no equivalent and immediate increase in demand, and the market will be out of balance. At the extremes, there can be two reactions: First, prices could fall (or simply not rise as much); this would curtail some firms' desire to supply goods, but, more importantly, it would stimulate demand for output. The most important demand stimulation would be with respect to foreign goods. Canadians would find it easier to export and to replace imports at home; that is, enhanced productivity would make Canadian goods more competitive. The second alternative, sluggish prices, would be that prices would adjust little, demand would stay put, and supply would instead be cut back by idling older plant and part of the work force. In this case, enhanced productivity is used to increase profit margins, but not necessarily total profits.

It is possible to examine the impact of both responses with the FOCUS model. The simulations discussed above were all run again with relatively flexible pricing. A selection of the results from the case of labour-and-capital productivity enhancement (Table A-1) is carried forward to Table 2. A simulation was also run with sluggish prices (Table A-4). In this case improved productivity is only gradually passed through to prices. There is a lag of up to five years; market forces prevail, but only slowly. Selected results are compared against those for flexible prices in Table 2.

Table 2, and a comparison of Tables A-1 and A-4, show that it is imperative that enhanced productivity, the productivity dividend, be passed throughout quickly to prices. As can be seen, without pass-through there is virtually no gain in GNP, in fact, labour-market dislocations would cause GNP loss for the first few years. Since there is no gain in GNP, but still some rise in output per worker, there are large employment losses; as seen in Table A-4, after ten years the unemployment rate is over 3 percentage points

TABLE 2

COMPARISON OF IMPACTS RESULTING FROM ALTERNATE PRICE RESPONSES

Assumptions - Money Growth Target
- No Tax Cuts
- Deficit Reduction Target

IMPACT	1985	1986	1987	1990	1994
Real GNP (% of base)					
Flexible Prices	0.2	0.5	1.0	2.6	4.9
Sluggish Prices	-0.3	-0.6	-0.7	-0.3	1.5
Employment (% of base)					
Flexible Prices	-0.1	-0.2	-0.3	-0.3	-0.6
Sluggish Prices	-1.0	-2.2	-3.1	-4.9	-5.8
Inflation (% pts)					
Flexible Prices	-0.6	-1.0	-0.9	-0.8	-0.8
Sluggish Prices	-0.1	-0.2	-0.3	-0.6	-0.9
Output per Employee (% of base)					
Flexible Prices	0.3	0.8	1.3	3.0	5.4
Sluggish Prices	0.1	0.2	0.3	0.6	1.0

NOTES:

Flexible Price Response: Labour/Capital Productivity Enhancement with "Market- Clearing" Prices (Appendix Table A-1)

Sluggish Price Response: Labour/Capital Productivity Enhancement with "Mark-Up" Prices (Appendix Table A-4)

FINDING:

Flexible price responses lead to preferable employment impacts.

above the base-case. There are still improvements in the government deficit, and in the balance of payments, but these are not as large as under productivity pass-through.

A full sluggish-price scenario like that of Table A-4 is unlikely to occur, especially in the longer run. Market forces would be too powerful to resist to such an extent. The reason why something like it might occur at all can be seen by comparing the entries for impacts on corporate profits as a percent of GNP in Table A-1 (flexible prices) and Table A-4 (sluggish prices). The exercise of market power by firms implicit in sluggish pricing increases the profit share of GNP, with a corresponding reduction in the share of wages and salaries. Although the increased share under sluggish prices is of a smaller GNP, there is also a bigger increase in real corporate profits (12.2%) above the base case under sluggish prices than under flexible prices (4.3%).

Thus, one danger in an enhancement of productivity is that all the dividend, or room to maneuver, will be used for short-sighted profit building. Market forces would probably make such an outcome unlikely in the long-term, but it could be a problem in the short-term. Major components of any productivity program should therefore be an agreement of some kind on income shares, and all reasonable measures to encourage the productivity dividend to be translated into long-term improvement in competitivity and not short-term improvement in balance sheets.

It should be noted that we have not tried an experiment in which productivity is somehow used to raise the income share of "wages and salaries". However, it would not be surprising if much the same results as above were forthcoming: namely, little reduction in inflation, little increase in competitivity, hence little increase in demand and GNP, and a large loss of jobs.

4.4.3 Wage Levels: Effects on Employment

Just as there is some question as to how firms will respond to enhanced productivity in the setting of their prices, so there are different possibilities for wage setting when productivity is boosted.

A standard presumption is that labour will negotiate so as to incorporate any increase in output per worker into a rise in real wages. Naturally, this does not occur all at once; the FOCUS model allows up to five years for full incorporation of productivity gains into wages to take place. This "standard" presumption was in fact the one built into the price variant described above.

An alternative possiblity is that labour would forego any real-wage increase above the base-case, thereby increasing the attractiveness of labour as a input to production and creating more jobs. In effect, this alternative uses labour's share of the productivity dividend to create higher employment rather than higher real incomes for those already employed.

Results for this alternative are presented in Table A-5, while Table 3 compares a selection of the alternative's results against an experiment will full real-wage gains (from Table A-1). As can be seen, the results of "spreading" labour's dividend to more individuals include higher GNP, lower inflation and an improvement in employment over the base case. If there are no real wage gains, in fact, after 10 years the unemployment rate is over 1 percentage point below the base case with improved productivity.

Comparing Tables A-1 and A-5 it will be noted that the additional gains in employment, GNP and inflation come with a small decline in the share of wages and salaries in GNP. However, it should be recalled that GNP is also higher in the "no-real-wage-gain" variant. Total wages and salaries actually rise more in this variant (5.9 percent above base after ten years) than with full real wage gain (5.5 percent after ten years).

TABLE 3

COMPARISON OF IMPACTS RESULTING FROM ALTERNATE WAGE RESPONSES

Assumptions - "Flexible" Price Response
- Money Growth Target
- No Tax Cuts
- Deficit Reduction Target

IMPACT	1985	1986	1987	1990	1994
Real GNP (% of base)					
Real Wage Gain	0.2	0.5	1.0	2.6	4.9
No Real Wage Gain	0.2	0.6	1.2	3.3	7.1
Employment (% of base)					
Real Wage Gain	-0.1	-0.2	-0.3	-0.3	-0.6
No Real Wage Gain	0	-0.1	0	0.6	1.8
Inflation (% pts)					
Real Wage Gain	-0.6	-1.0	-0.9	-0.8	-0.8
No Real Wage Gain	-0.8	-1.2	-1.0	-1.3	-1.5
Output per Employee (% of base)					
Real Wage Gain	0.3	0.8	1.3	3.0	5.4
No Real Wage Gain	0.3	0.7	1.2	2.8	5.1

NOTES:

Real Wage Gain: Real wages grow with productivity increase (Appendix Table A-1)

No Real Wage Gain: Base-case real wage maintained (Appendix Table A-5)

FINDING

No real wage gains lead to significant new employment creation.

The FOCUS model measures employment in terms of number of individuals employed, not in terms of hours worked. No real wage gain in the model means no real wage gain per employed person, not per hour. Thus one way in which the variant could be achieved is though a reduction in working hours with no corresponding change in per-person real pay. The productivity dividend is then taken partly as leisure by the employed who work less, and partly as employment by those who would otherwise have been unemployed. Note that in Table A-5, output per worker is about 5 percent above the base case after ten years; this indicates that something less than a 5 percent decrease in the work week (2-3 hours) would be needed to convert the productivity dividend into leisure and sufficient new jobs to prevent any long-term unemployment from a productivity enhancement of 0.5 percent per year.

There are, of course, numerous legal and traditional impediments to work-week reduction in the economy, and the model simulations can tell us nothing about how they might be overcome. The simulations do indicate that in terms of the overall economy, work-week reduction with corresponding productivity enhancement could yield significant benefits. They also indicate that large-scale unemployment from productivity enhancement need not be feared as long as productivity is used to enhance competitiveness, and if at least some of the productivity dividend is re-directed to job creation.

4.5 Alternative Macroeconomic Contexts and Productivity Improvement

The section above showed that it is possible for us to influence some of the impact of productivity enhancement through the setting of wages and prices. Can the impact of productivity enhancement also be altered through use of the more common monetary and fiscal levers? The present section shows that this is indeed the case, and that these factors are of major importance in determining the employment impacts of technological change.

4.5.1 Money and Exchange-Rate Responses: Effects on Employment

The question of how to set monetary policy is a long-standing one in economics. It is clear that the Bank of Canada has followed a number of principles over the years. One common rule is to establish a target rate of money growth and to stick to it in the longer-term even if economic conditions alter.

Under this principle the Bank is primarily concerned with establishing and maintaining a low rate of inflation. An alternative target is the Canadian exchange rate; if this target is chosen, the Bank will lower interest rates (by expanding the money supply) if the dollar attempts to appreciate above target, and will raise rates if it threatens to depreciate. Naturally, any combination of these targets is also possible. All the simulations presented thus far have been conducted with a money target. That is, the Bank of Canada was presumed to keep the money supply growing at the same rate as in the base case despite the productivity enhancement imposed on the economy and despite any reactions of prices and wages.

In this sub-section two alternatives will be examined. As for the alternatives discussed earlier, the comparison simulation will be the one presented in Table A-1. This simulation also features a money target, and has mixed capital/labour productivity enhancement of 0.5 percent per year with flexible price response and real-wage gains.

The simulation shown in Table A-1 generated a large surplus in the balance of payments due to increased Canadian competitiveness. The surplus generated in the simulation would in fact be too large for the Bank of Canada to add to its foreign-exchange reserves; the simulation of Table A-1 is thus incomplete. Two major alternatives are that the Canadian dollar would appreciate, making

Canadian goods relatively more expensive and thus reducing the surplus, or that Canadian interest rates would fall to keep the exchange-rate on target, giving less net borrowing abroad (or capital inflow) and reducing the surplus through the capital account. The "appreciation" alternative is summarized in Table A-6, and the "exchange-rate target" simulation in Table A-7. Key results of each are compared in Table 4.

The result of permitting the exchange rate to appreciate through the productivity dividend is to reduce the positive impact on GNP in earlier years and to reinforce the downward pressure on inflation. Thus, permitting the dollar to appreciate transforms the dividend into an inflation-fighting tool. As it happens, the reduced inflation builds a powerful momentum which serves later to offset the effect of the appreciation on Canadian competitiveness; thus the total ten-year effect on GNP is almost the same as in the money target simulation. However, there is a greater job loss, especially in the earlier years, since nominal wages are somewhat slow to react to reduced inflation. Labour thus becomes relatively more expensive for a period of years, and there is more substitution away from labour in production.

When the exchange rate is the target of monetary policy, the Bank of Canada uses the productivity dividend to reduce interest rates and stimulate real growth. As can be seen in Table A-7 the bond rate is over 3 percentage points lower after 10 years and investment has been given a big stimulus. The positive impact of productivity enhancement on real GNP is reinforced; over ten years GNP is increased a total of $168 billion, against an increase of $121 billion with no rate reduction. The extra GNP leads to extra jobs, so that under this alternative there is new job creation of 156,000 person-years over a 10-year span. Note, also, that pursuit of growth has spilled over into an increase in the inflation rate of just over one-half a percent.

TABLE 4

COMPARISION OF IMPACTS RESULTING FROM ALTERNATE MONEY/EXCHANGE-RATE RESPONSES

Assumptions - "Flexible" Price Responses
- Real Wage Gains

IMPACT	1985	1986	1987	1990	1994
Real GNP (% of base)					
Money Target	0.2	0.5	1.0	2.6	4.9
Appreciation	0	0.2	0.7	2.8	6.0
Exchange-Rate Target	0.2	0.6	1.2	3.5	7.2
Employment (% of base)					
Money Target	-0.1	-0.2	-0.3	-0.3	-0.6
Appreciation	-0.1	-0.5	-0.6	-0.5	-0.5
Exchange-Rate Target	-0.1	-0.1	-0.1	0.1	0.4
Inflation (% pts)					
Money Target	-0.6	-1.0	-0.9	-0.8	-0.8
Appreciation	-1.0	-1.8	-1.8	-1.8	-1.7
Exchange-Rate Target	0.6	0.8	0.8	0.6	0.6
Output per Employee (% of base)					
Money Target	0.3	0.8	1.3	3.0	5.4
Appreciation	0.2	0.7	1.3	3.1	5.9
Exchange-Rate Target	0.3	0.8	1.3	3.2	6.1

NOTES:

Money Target: Money Growth as in Base, No change in exchange rate (Appendix Table A-1)

Appreciation: Money growth as in Base, exchange rate appreciates (Appendix Table A-6)

Exchange-Rate Target: Money supply expands to maintain base-case exchange rate (Appendix Table A-7)

FINDING:

An exchange-rate target leads to employment gains.

In brief, the two alternatives examined show that the responses of the Bank of Canada can have a major effect on the impact of productivity enhancement. Monetary policy has the power to transform enhanced productivity into inflation fighting at the cost of some technological unemployment, or into greater growth, which may lead to employment gains.

4.5.2 Fiscal Responses: Effects on Employment

The basic comparison of productivity enhancement (Table A-1) showed another productivity dividend in terms of a sizeable reduction of the aggregate government deficit. After ten years, accumulated deficits of all levels of government combined would be reduced by over $20 billion below the base case. Using all of the dividend to indeed reduce the deficit would be a relatively cautious fiscal policy. An alternative would be to use some or all of the dividend to instead reduce taxes or increase expenditure, thus re-injecting the dividend back into growth.

To bound the possibilities, an alternative has been run in which all of the dividend is re-injected. Specifically, personal taxes have been cut so as to lead to no net change in the deficit year by year. The results of this simulation are summarized in Table A-8, and compared against the deficit-reduction case in Table 5.

As can be seen, the effect of re-injecting government's share of the dividend is modest but helpful to employment. There is a small increase in the impact on GNP while total person-years lost are reduced. There is almost no change in the impact on inflation.

The simulation shows that across-the-board fiscal policy, such as general tax cuts, may not have a major effect on the output and employment outcomes of a major productivity enhancement. Certainly there seems to be far more room to maneuver on the side of monetary and exchange-rate factors. However, fiscal policy need not always be in the form of very general policies.

TABLE 5

COMPARISON OF IMPACTS RESULTING FROM ALTERNATE FISCAL RESPONSES

Assumptions - Flexible Prices
- Real Wage Gains
- Money Growth Target

IMPACT	1985	1986	1987	1990	1994
Real GNP (% of base)					
No Policy Change	0.2	0.5	1.0	2.6	4.9
Tax Cut	0.1	0.5	1.0	2.7	5.0
Employment (% of base)					
No Policy Change	-0.1	-0.2	-0.3	-0.3	-0.6
Tax Cut	-0.1	-0.3	-0.3	-0.3	-0.4
Inflation (% pts)					
No Policy Change	-0.6	-1.0	-0.9	-0.8	-0.8
Tax Cut	-0.7	-1.0	-0.8	-0.7	-0.6
Output per Employee (% of base)					
No Policy Change	0.3	0.8	1.3	3.0	5.4
Tax Cut	0.2	0.8	1.3	3.0	5.4

NOTES:

No Policy Change: Government tax rates and spending as in base (Appendix Table A-1)

Tax Cut: Personal taxes altered so as to maintain base-case surplus/deficit (Appendix Table A-8)

FINDING:

Alternate fiscal responses have little effect on employment.

The comparison case shows us that productivity enhancement will serve, on its own, to reduce government deficits. Governments should therefore have available a pool of additional funds from which to establish special programs to aid the sometimes painful transition of firms, workers and communities to new-technology regimes. Unfortunately, it is not possible to use aggregate models to investigate these possibilities, but the model's results do show that enhanced productivity can itself make additional government funds available.

4.6 Summary: A Range of Outcomes

The various model simulations suggest a number of lessons about the impact of productivity enhancement under various possible responses of the economy. The lessons may be summarized as follows:

1) The nature and extent of the employment impacts of technological change do not depend primarily on the nature of the technology itself, whether it is capital or labour saving or both, but rather are much more sensitive to other factors in the macroeconomy;

2) Price-setting matters. If the productivity dividend resulting from technological change is not passed through into more competitive prices then significant loss of employment could result.

3) Wage-setting also matters. Significant possibilities exist to mitigate job loss, or create new employment, by transforming the productivity dividend, not into higher real wages for workers employed, but instead into more jobs.

4) Money and exchange rate setting matter. The Bank of Canada has the power to convert enhanced productivity into inflation reduction (at the expense of lost employment) or into sufficient extra growth to prevent any unemployment associated with technological change.

5) Aggregate fiscal responses may not matter as much. Any technological unemployment can be reduced only a little by broad fiscal tools without at least short term increases in the deficit. However, enhanced productivity will provide extra funds to governments with which to facilitate technological transition.

Thus, in general, depending on how price and wage setting mechanisms respond, a wide range of outcomes may accompany productivity enhancement. A selection of these outcomes is summarized in Table 6. For a "Pessimistic" outcome we need look no further than a situation of sluggish or non-competitive pricing (Table A-5). While very unlikely to prevail in the longer-term, such an outcome is more possible in the short-run and must be guarded against.

A "cautious" approach is contained in the principal comparison simulation used above (See Table A-1). This case presumes a flexible price response, but features more anti-inflationary monetary and fiscal responses. It also contains a full pass-through of productivity gains into real wage gains.

A much more innovative approach is the option of switching from real-wage gains into job creation, possibly through a system of worksharing or general hours reduction. This case yields significant net job creation and is summarized in Table A-5 which examines the "No Real Wage Gains" case.

Finally, an "Optimistic" case has been generated by presuming employment-directed responses of real-wage setting and accommodating monetary and fiscal responses (see Table A-9). This case shows a very large increase in GNP, a reduction in inflation, and sufficient net new job creation (almost 1.9 million person-years) to cut the unemployment rate by over 2 percentage points after ten years.

TABLE 6

COMPARISON OF IMPACTS OF PRODUCTIVITY INCREASES - A RANGE OF OUTCOMES

IMPACT	1985	1986	1987	1990	1994
Real GNP (% of base)					
Optimistic	0.2	0.8	1.5	4.4	9.9
No Real Wage Gain	0.2	0.6	1.2	3.3	7.1
Cautious	0.2	0.5	1.0	2.6	4.9
Pessimistic	-0.3	-0.6	-0.7	-0.3	1.5
Employment (% of base)					
Optimistic	0.0	0.0	0.3	1.4	3.8
No Real Wage Gain	0.0	-0.1	0.0	0.6	1.8
Cautious	-0.1	-0.2	-0.3	-0.3	-0.6
Pessimistic	-1.0	-2.2	-3.1	-4.9	-5.8
Inflation (% pts)					
Optimistic	-0.8	-1.0	-0.9	-1.1	-1.5
No Real Wage Gain	-0.8	-1.2	-1.0	-1.3	-1.5
Cautious	-0.6	-1.0	-0.9	-0.8	-0.8
Pessimistic	-0.1	-0.2	-0.3	-0.6	-0.9

NOTES:

Optimistic: See Appendix Table A-9

No Real Wage Gain: See Appendix Table A-5

Cautious: See Appendix Table A-1

Pessimistic: See Appendix Table A-4

FINDING:

"Flexible" price response, exchange rate money target, and no real wage gains lead to the greatest GNP growth, and significant employment gains.

FOOTNOTES

1) Chase Econometrics, "The impact of microelectronics on employment and economic growth in the 1980s" (Toronto, July, 1981). Informetrica, "Technology, labour markets and the economy", (Ottawa, Nov. 1983).

2) See, for example, R. Dornbusch, Macroeconomics, (McGraw-Hill, 1982) p. 456; Ostry and Zaidi, Labour Economics, (Macmillan, 1979) p. 106; Ministry of State for Science and Technology, Towards the 1990s: Technology development for Canada, (1983); and "Jobs and Technology" in The Economist, March 23, 1984.

3) See, for example, E. Appelbaum, "The economics of technical Progress: labour issues arising from the spread of programmable automation technologies", (1982); Canadian Labour Congress, "Technological change and Work", (1982); and the AFL/CIO, "The future of work", (August, 1983).

4) For a further discussion of this see cf. Ostry and Zaidi, op. cit. p. 146-7, 151.

5) For example, Denny, M. and Fuss, M., Productivity: a selective survey of recent developments and the Canadian experience, (Toronto, Economic Council of Ontario, 1983).

6) Soete, L. and Freeman, C., "New technologies, investment and employment growth". A paper presented to the inter-governmental conference on employment growth in the context of structural change, (OECD, 1984).

7) Whitley, J. D. and Wilson, R. A., "Quantifying the employment effects of microelectronics", in Futures, (December, 1982).

8) Davenport, P. "Capital-using technical change and long-period unemployment in Canada: 1953-81" in the Journal of Post-Keynesian Economics, (Fall, 1982).

9) Ontario Economic Council. Policies for Stagflation, Report of a Conference Sponsored by The Ontario Economic Council, (Toronto, 1981).

10) Several factors may affect the rate of inter-industry diffusion: industry concentration, firm size and the size of the domestic market for a product, profitability, uncertainty about the technology, and whether or not the products in question are internationally traded.

11) Stoneman, P., The Economic analysis of technological change, (Oxford University Press, 1983), p. 178f.

12) Younger, A., "How many jobs? the impact of technological change on new job creation" in IDEAS on Innovation, (May, 1984).

13) Ibid.

APPENDIX A - DETAILED RESULTS OF THE IMPACT OF PRODUCTIVITY IMPROVEMENTS

TABLE A-1

IMPACTS RESULTING FROM LABOUR/CAPITAL PRODUCTIVITY ENHANCEMENT

(0.5% PER YEAR ABOVE BASE-CASE)

Assumptions - "Flexible" Price Response
- Money Growth Target
- Real Wage Gains

IMPACT	1985	1986	1987	1990	1994
Real GNP (% of Base)	0.2	0.5	1.0	2.6	4.9
GNP Growth Rate (% pts)	0.2	0.4	0.5	0.5	0.6
Inflation (% pts)	-0.6	-1.0	-0.9	-0.8	-0.8
Unemployment Rate (% pts)	0.05	0.13	0.15	0.20	0.34
Employment (% of Base)	-0.1	-0.2	-0.3	-0.3	-0.6
Output per Employee (% of Base)	0.3	0.8	1.3	3.0	5.4
Real Wage (% of Base)	0.2	0.4	0.6	1.6	3.4
Bond Rate (% pts)	0.0	-0.1	-0.2	-0.5	-0.8
Government Balance (Bill$)	-0.6	-0.7	0.2	2.1	5.8
Current Account (Bill$)	0.2	1.1	2.3	5.7	13.3
Consumption (% of Base)	0.0	0.0	0.0	0.3	1.0
Investment (Mach & Equip) (% of Base)	-0.3	-0.9	-0.7	0.8	1.9
Share of Corporate Profits (% pts)	-0.2	-0.1	-0.1	0.0	-0.1
Share of Wages & Salaries (% pts GNP)	0.1	0.0	0.0	0.0	0.3

TABLE A-2

IMPACTS RESULTING FROM CAPITAL PRODUCTIVITY ENHANCEMENT

(NEW MACHINERY AND EQUIPMENT 20%) (PLANT 5%)

Assumptions - "Flexible" Price Response
- Money Growth Target
- Real Wage Gains

IMPACT	1985	1986	1987	1990	1994
Real GNP (% of Base)	0.3	0.8	1.6	3.5	5.0
GNP Growth Rate (% pts)	0.3	0.6	0.8	0.5	0.3
Inflation (% pts)	-1.1	-1.5	-1.2	-0.6	-0.3
Unemployment Rate (% pts)	0.08	0.20	0.22	0.21	0.30
Employment (% of Base)	-0.1	-0.3	-0.4	-0.4	-0.5
Output per Employee (% of Base)	0.4	1.2	2.0	3.8	5.3
Real Wage (% of Base)	0.4	0.7	0.8	2.2	3.8
Bond Rate (% pts)	-	-0.2	-0.3	-0.7	-0.7
Government Balance (Bill$)	-1.0	-1.0	0.6	3.5	6.6
Current Account (Bill$)	0.4	1.8	3.5	7.3	13.0
Consumption (% of Base)	-	-	-	0.5	1.2
Investment (Mach & Equip) (% of Base)	-0.6	-1.5	-1.1	1.7	2.5
Share of Corporate Profits (% pts)	-0.3	-0.2	-0.1	-0.1	-0.1
Share of Wages & Salaries (% pts)	0.1	0.1	-	0.1	0.4

TABLE A-3

IMPACTS RESULTING FROM LABOUR PRODUCTIVITY ENHANCEMENT

(0.5% PER YEAR ABOVE BASE-CASE)

Assumptions - "Flexible" Price Response
- Money Growth Target
- Real Wage Gains

IMPACT	1985	1986	1987	1990	1994
Real GNP (% of Base)	0.2	0.4	0.7	1.7	3.1
GNP Growth Rate (% pts)	0.2	0.3	0.3	0.3	0.4
Inflation (% pts)	-0.6	-0.6	-0.5	-0.5	-0.5
Unemployment Rate (% pts)	0.05	0.09	0.09	0.13	0.21
Employment (% of Base)	-0.1	-0.1	-0.1	-0.2	-0.4
Output per Employee (% of Base)	0.3	0.6	0.9	1.9	3.4
Real Wage (% of Base)	0.2	0.3	0.4	1.1	2.2
Bond Rate (% pts)	0.0	-0.1	-0.1	-0.3	-0.5
Government Balance (Bill$)	-0.5	-0.2	0.3	1.2	3.5
Current Account (Bill$)	0.3	0.9	1.5	3.6	8.3
Consumption (% of Base)	-	-	-	0.3	0.6
Investment (Mach & Equip) (% of Base)	-0.4	-0.6	-0.3	0.5	1.2
Share of Corporate Profits (% pts)	0.1	0.0	0.0	0.0	-0.1
Share of Wages & Salaries (% pts)	0.0	0.0	0.0	0.0	0.2

TABLE A-4

IMPACT RESULTING FROM LABOUR/CAPITAL PRODUCTIVITY ENHANCEMENT WITH "MARK-UP" PRICES

Assumptions - "Mark-Up" Price Response
- Money Growth Target
- Real Wage Gains

IMPACT	1985	1986	1987	1990	1994
Real GNP (% of Base)	-0.3	-0.6	-0.7	-0.3	1.5
GNP Growth Rate (% pts)	-0.3	-0.3	-0.1	0.3	0.5
Inflation(% pts)	-0.1	-0.2	-0.3	-0.6	-0.9
Unemployment Rate (% pts)	0.60	1.33	1.87	3.01	3.59
Employment (% of Base)	-1.0	-2.2	-3.1	-4.9	-5.8
Output per Employee (% of Base)	0.1	0.2	0.3	0.6	1.0
Real Wage (% of Base)	0.0	0.1	0.3	1.0	0.9
Bond Rate (% pts)	0.0	-0.1	-0.2	-0.6	-1.0
Government Balance (Bill$)	-0.2	-0.2	0.1	1.0	4.8
Current Account (Bill$)	0.1	0.6	1.2	3.7	9.9
Consumption (% of Base)	0.5	-1.1	-1.6	-2.6	-3.0
Investment (Mach & Equip) (% of Base)	-0.1	-0.2	-0.1	1.0	3.0
Share of Corporate Profits (% pts)	0.2	0.5	0.5	0.7	1.1
Share of Wages & Salaries (% pts)	-0.4	-0.8	-1.1	-1.6	-2.4

TABLE A-5

IMPACTS RESULTING FROM LABOUR/CAPITAL PRODUCTIVITY ENHANCEMENT WITH NO REAL WAGE GAINS

Assumptions - "Flexible" Price Response
- Money Growth Target
- No Real Wage Gain

IMPACT	1985	1986	1987	1990	1994
Real GNP (% of Base)	0.2	0.6	1.2	3.3	7.1
GNP Growth Rate (% pts)	0.2	0.5	0.6	0.8	1.0
Inflation(% pts)	-0.8	-1.2	-1.0	-1.3	-1.5
Unemployment Rate (% pts)	0.02	0.03	-0.01	-0.35	-1.13
Employment (% of Base)	0.0	-0.1	0.0	0.6	1.8
Output per Employee (% of Base)	0.3	0.7	1.2	2.8	5.1
Real Wage (% of Base)	0.0	0.0	0.0	0.0	0.0
Bond Rate (% pts)	0.0	-0.1	-0.3	-0.7	-1.3
Government Balance (Bill$)	-0.7	-0.5	0.7	3.7	12.0
Current Account (Bill$)	0.3	1.3	2.6	7.0	18.2
Consumption (% of Base)	0.0	0.0	0.0	0.3	1.0
Investment (Mach & Equip) (% of Base)	-0.4	-1.0	-0.7	1.2	3.9
Share of Corporate Profits (% pts)	-0.2	-0.1	0.0	0.4	0.7
Wages & Salaries (% pts)	0.0	-0.1	-0.2	-0.4	-0.6

TABLE A-6

IMPACTS RESULTING FROM LABOUR/CAPITAL PRODUCTIVITY ENHANCEMENT WITH APPRECIATING EXCHANGE RATE

Assumptions - "Flexible" Price Response
- Money Growth Target with Appreciating Exchange Rate
- Real Wage Gains

IMPACT	1985	1986	1987	1990	1994
Real GNP (% of Base)	0.0	0.2	0.7	2.8	6.0
GNP Growth Rate (% pts)	0.0	0.2	0.4	0.6	1.1
Inflation(% pts)	-1.0	-1.8	-1.8	-1.8	-1.7
Unemployment Rate (% pts)	0.09	0.27	0.37	0.28	0.29
Employment (% of Base)	-0.1	-0.5	-0.6	-0.5	-0.5
Output per Employee (% of Base)	0.2	0.7	1.3	3.1	5.9
Real Wage (% of Base)	0.3	0.6	0.7	1.6	3.2
Bond Rate (% pts)	0.0	-0.3	-0.6	-1.4	-3.1
Government Balance (Bill$)	-1.3	-2.2	-1.3	1.0	7.2
Current Account (Bill$)	0.4	1.1	2.2	5.3	11.0
Consumption (% of Base)	0.0	0.0	-0.2	0.2	0.5
Investment (Mach & Equip) (% of Base)	-0.8	-2.1	-2.0	2.1	6.9
Share of Corporate Profits (% pts)	-0.4	-0.5	-0.4	-0.3	-0.4
Share of Wages & Salaries (% pts)	0.1	0.1	0.0	-0.1	0.1
Exchange Rate (U.S. ¢)	0.8	1.6	2.5	4.0	7.9

TABLE A-7

IMPACTS RESULTING FROM LABOUR/CAPITAL PRODUCTIVITY ENHANCEMENT WITH EXCHANGE RATE MONEY TARGET

Assumptions - Exchange Rate Money Target
- Flexible Prices
- Real Wage Gains
- Effective Lower Interest Rates

IMPACT	1985	1986	1987	1990	1994
Real GNP (% of Base)	0.2	0.6	1.2	3.5	7.2
GNP Growth Rate (% pts)	0.2	0.5	0.6	0.8	1.0
Inflation (% pts)	0.6	0.8	0.8	0.6	0.6
Unemployment Rate (% pts)	0.03	0.06	0.03	-0.07	-0.28
Employment (% of Base)	-0.1	-0.1	-0.1	0.1	0.4
Labour Productivity (% of Base)	0.3	0.8	1.3	3.2	6.1
Real Wage (% of Base)	0.2	0.4	0.6	2.0	3.6
Bond Rate (% pts)	0.0	-0.3	-0.7	-1.9	-3.7
Government Surplus Deficit (Bill$)	-0.5	-0.2	0.9	4.1	10.8
Current Account (Bill$)	0.2	1.0	1.9	5.6	13.3
Consumption (% of Base)	0.0	0.0	0.1	0.7	2.1
Investment (Mach & Equip) (% of Base)	-0.2	-0.1	0.8	4.1	10.1
Share of Corporate Profits (% pts)	-0.2	-0.1	-0.1	-0.1	-0.5
Share of Wages & Salaries (% pts)	0.0	0.0	0.0	0.0	-0.5

TABLE A-8

IMPACTS RESULTING FROM LABOUR/CAPITAL PRODUCTIVITY ENHANCEMENT WITH FULL TAX CUT

Assumptions - Full Tax Cut
- Money Growth Target
- Flexible Prices
- Real Wage Gains

IMPACT	1985	1986	1987	1990	1994
Real GNP (% of Base)	0.1	0.5	1.0	2.7	5.0
GNP Growth Rate (% pts)	0.1	0.4	0.6	0.6	0.6
Inflation(% pts)	-0.7	-1.0	-0.8	-0.7	-0.6
Unemployment Rate (% pts)	0.06	0.16	0.15	0.15	0.25
Employment (% of Base)	-0.1	-0.3	-0.3	-0.3	-0.4
Labour Productivity (% of Base)	0.2	0.8	1.3	3.0	5.4
Real Wage (% of Base)	0.2	0.4	.5	1.7	3.5
Bond Rate (% pts)	0.0	-0.1	-0.2	-0.5	-0.6
Government Surplus Deficit (Bill$)	0.0	0.0	0.0	0.0	0.0
Current Account (Bill$)	0.4	1.5	2.4	5.0	10.5
Consumption (% of Base)	-0.1	-0.2	0.0	0.7	2.0
Investment (Mach & Equip) (% of Base)	-0.4	-1.0	-0.7	0.7	1.8
Share of Corporate Profits (% pts)	-0.2	-0.2	-0.1	-0.1	0.0
Share of Wages & Salaries (% pts)	0.1	0.1	0.1	0.0	0.3

TABLE A-9

IMPACTS RESULTING FROM LABOUR/CAPITAL PRODUCTIVITY ENHANCEMENT WITH OPTIMISTIC ASSUMPTIONS

Assumptions - "Flexible" Price Response
-Exchange Rate Money Target
-No Real Wage Gain
-Full Tax Cut

IMPACT	1985	1986	1987	1990	1994
Real GNP (% of Base)	0.2	0.8	1.5	4.4	9.9
GNP Growth Rate (% pts)	0.2	0.6	0.8	1.1	1.4
Inflation (% pts)	-0.8	-1.0	-0.9	-1.1	-1.5
Unemployment Rate (% pts)	0.01	-0.03	-0.15	-0.82	-2.29
Employment (% of Base)	0.0	0.0	0.3	1.4	3.8
Output per Employee (% of Base)	0.2	0.8	1.3	3.0	5.5
Real Wage (% of Base)	0.0	0.0	0.0	0.0	0.0
Bond Rate (% pts)	-0.1	-0.4	-0.7	-1.7	-3.0
Government Balance (Bill$)	0.0	0.0	0.0	0.0	0.0
Current Account (Bill$)	0.3	1.2	1.9	4.8	12.8
Consumption (% of Base)	-0.1	0.0	0.3	1.7	4.8
Investment (Mach & Equip) (% of Base)	-0.2	0.0	1.0	4.1	8.3
Share of Corporate Profits (% pts)	-0.2	-0.1	0.0	0.5	0.9
Share of Wages & Salaries (% pts)	0.0	-0.2	-0.3	-0.7	-0.9

APPENDIX B - THE BASE CASE PROJECTION

This report assesses the employment impacts of various types of productivity improvements and their sensitivity to the economic environment in which the change is occurring. The research was conducted using the FOCUS model of the Canadian economy, developed and maintained by the Institute for Policy Analysis of the University of Toronto.

In the first part of the research, different types of productivity improvement, as a proxy for technological change, were entered into the model and the results compared to a base case projection. The marginal difference between the results and the base case projection indicates the likely direction and magnitude of the impacts which would result from those productivity improvements. Subsequently, one type of productivity improvement was selected, and different assumptions about the economic environment, which were held constant for the first part of the research, were selectively relaxed.

The base case projection, relative to which the research was conducted, is the medium growth scenario prepared by the Institute in December 1983 as part of its ongoing research.[1] Its essential features are described as follows.

Since the Canadian economy is so highly influenced by changes in the United States, one of the most important inputs into the model is a projection for the U.S. economy. The base case projection uses data supplied by Data Resources Inc., which was released in November 1983. The data was adjusted "by hand" to reflect a lower real growth path and lower inflation rates, with historically high real interest rates. The base case projection assumes sustained U.S. growth, trending towards a slightly lower potential growth path. The inflation gains of the last recession are retained, but with

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1. For a detailed description of the base case see, Peter Dungan, National Projection Through 2005 and Provincial Projections Through 1995, PEAP Policy Study No. 84-2, Institute for Policy Analysis, University of Toronto, 1984.

inflation resisting a fall below 4.0 percent. Real interest rates decline gradually over the projection period.

Real GNP in Canada is projected to grow at an average annual rate of 3.3 percent over the projection period. The inflation gains of the last two years are maintained due to persistent slack in the economy. Inflation averages just over 5 percent over the period, which is slightly above the U.S. figure. Interest rates remain high, but decline from a projected 12.0 percent in 1985 to almost 8 percent in 1995. The unemployment rate remains high for the remainder of the decade, but begins to decline significantly by 1995.

The population projection for this research are based on the work conducted by David Foot, updated using current data.[2] Foot's average projection was used, which assumes intermediate fertility and mortality rates, and net immigration slightly over 60,000 per year.

This projection features a gradually aging population, with growth in the younger age cohorts falling over the projection period. Employment growth in Canada slows to an average 2.3 percent per year, from an average of 3.1 percent in the 1970s. However, this decline is matched by a decrease in labour force growth, particularly among new entrants to the labour force in the younger age cohorts.

In preparing the base case a number of assumptions were made about the economic environment. The base case assumes that the Bank of Canada will continue to attempt to control the growth in the money supply to help restrain inflation, and the federal government will also continue to pursue a deficit reduction target, and will not take a stimulative tax cut approach. The base case also features relatively flexible responses of prices to reductions in costs due to productivity gains. Increases in productivity will also tend to lead to higher real wage gains.

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2. See David Foot, Canada's Population Outlook, Canadian Institute for Economic Policy, Ottawa, 1982, for a further explanation of this projection.

SUMMARY OF THE MAJOR BASE CASE ASSUMPTIONS (AVERAGE 1985-1995)

U.S. Real Growth	(%)	2.9
U.S. Inflation	(%)	4.7
U.S. Long Term Bond Rate	(%)	8.9
Canadian Real Growth	(%)	3.3
Canadian Inflation	(%)	5.4
Canadian Long Term Bond Rate	(%)	10.2

SUMMARY OF BASE CASE POPULATION AND LABOUR MARKET PROJECTIONS (AVERAGE 1985-1995)

Canadian Population Growth	(%)	0.75
Labour Force Source Population Growth	(%)	0.97
Employment Growth	(%)	1.95
Unemployment Rate	(%)	8.79

BASE CASE PROJECTIONS

	1985	1986	1987	1990	1994
Real GNP (Bill $)	144.2	148.5	153.7	168.4	186.7
Change in Real GNP (%)	3.6	3.0	3.5	2.3	2.5
Inflation (%)	5.2	4.4	5.6	4.4	4.7
Unemployment Rate (%)	10.0	9.64	9.13	7.73	6.84
Employment (000's)	11214	11424	11664	12454	13330
Output/Employee (% Change)	1.3	1.20	1.39	0.52	0.59
Real Annual Wage per Employee (% Change)	0.09	0.2	0.11	0.04	0.45
Bond Rate (%)	12.00	11.45	10.82	8.31	8.10
Government Balance (Bill $)	-11.110	-9.752	-7.822	-5.323	0.464
Current Account (Bill $)	-0.7	-1.424	-1.598	-1.202	3.036
Consumption (% of GNP)	63.0	63.3	63.2	62.7	62.7
Investment (% of GNP)	13.9	14.2	15.2	17.6	19.4
Pre-Tax Corporate Profits (% of GNP)	10.2	10.5	11.1	11.4	11.4
Wages & Salaries (% of GNP)	54.6	53.8	53.2	52.2	51.1

SECTION II

THE IMPACT OF INCREASING PRODUCTIVITY ON EMPLOYMENT IN ONTARIO

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THE IMPACT OF INCREASING PRODUCTIVITY ON EMPLOYMENT IN ONTARIO

SUMMARY

Economic projections for the next ten years generally call for modest increases in real GNP of 2.5-3% per year, annual productivity growth of about 1%, and a slow decline in the unemployment rate from 11% now to about 6% by 1995. If productivity could be increased an extra 5% over the next ten years, real GNP could be 5% higher, and unemployment could be reduced faster, provided that prices and wages respond in a reasonably competitive manner. If the gains from productivity growth are instead used to increase profit margins, unemployment could stay at 8% or more. A similar result is likely if most of the benefits go into real wage increases.

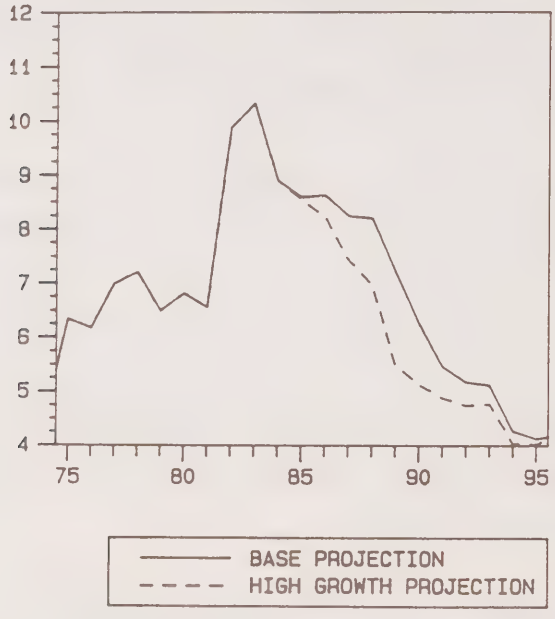
Past periods of high productivity growth in Canada have been characterized by high rates of real income growth and low rates of unemployment. Unanticipated slowing of productivity growth in the seventies, and a succession of inflationary shocks have caused real wages to grow faster than productivity. Wage settlements have come down, but there is still understandable resistance to settle for wage increases below the rate of inflation. This is making it difficult to increase employment fast enough to reduce the unemployment rate quickly.

Would this situation be helped or hurt if Canada and Ontario could generate an extra 5% productivity over the next ten years? Most Canadians recognize that foreign productivity growth has reduced our ability to compete internationally in certain areas. Shocked by a loss of 350,000 jobs in the 1982 recession, many fear that increased domestic productivity growth will have the same effects.

Our analysis indicates that this does not have to be the case. We introduced the change in productivity into our "most likely" Chase forecast for Canada and Ontario, and considered a wide range of possible behavioural responses by producers and workers. We selected three cases which illustrate the range of outcomes most clearly.

The first case assumes that extra productivity will not translate into higher real wages than are incorporated in the base case until the unemployment rate approaches the 6% range. Producers use the lower unit labour cost to keep prices as low as possible, in order to maximize sales. This case assumes that "everyone is reasonable." Its behavioural responses are very close to those actually experienced in the fifties and sixties.

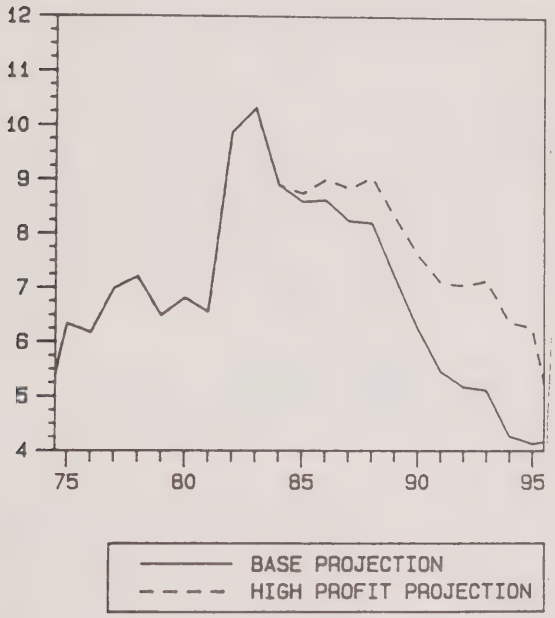
Ontario Unemployment Rate
High Growth - High Employment Case



The result is a "high growth - high employment" outcome. The unemployed can find jobs faster than in the base projection, since higher productivity and unchanged real wages make them more employable. At the same time, aggressive pricing is making it possible to sustain a higher production volume. After ten years, real GNP and real wages per worker have increased roughly 5%. The long-term trend away from manufacturing towards services is reflected in lower employment in manufacturing and higher employment in service producing industries.

Things turn out worse if the gains from productivity are not shared appropriately. Our second case assumes that producers have the ability to divert the gains from lower unit labour cost into continuously increasing higher profit margins. Real wages are unchanged from the base projection. Opportunities for sales expansion through price competition are not pursued. Some of the more common pessimistic employment-productivity scenarios tend to correspond to the behaviour implied in this case.

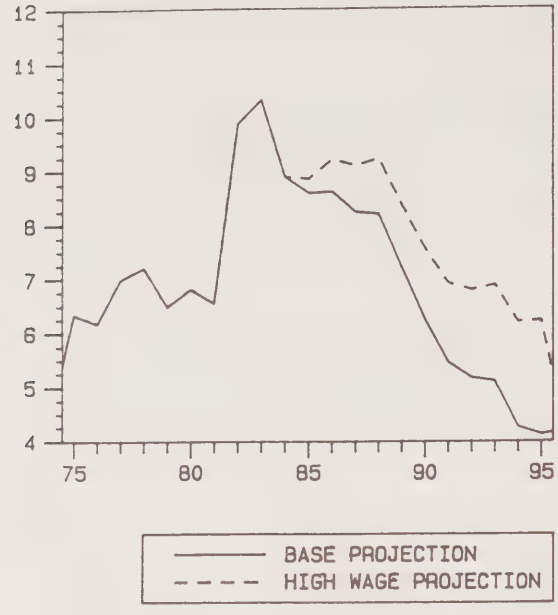
Ontario Unemployment Rate
High Profit - Low Employment Case



These assumptions yield a "high profit - low employment" outcome. Investors collect more income, workers collect less. Increased productivity is not reflected in prices. Hence, no extra sales result. Consequently, there are 110,000 fewer Ontario jobs in the higher productivity environment by 1995, relative to the base projection. The control over profit margins assumed here is only realistic over an extended period for industries with few producers, and protected from foreign competition.

The third case pictures an environment in which the bulk of the gains from productivity go into real wage increases, and reductions in the length of the workweek without loss of pay. The unit cost of production is unchanged.

Ontario Unemployment Rate
High Wage - Low Employment Case



The results are similar to those in the previous case. Price competitiveness is not improved. Fewer workers are sharing the same total nominal before tax wage income, and, as in the previous case, the unemployment rate is about 2% higher by 1995 compared to our base projection. The behaviour implicit in this scenario is one of extreme scepticism about the impact of technology. The emphasis is on protecting jobs and incomes. In being overly defensive, the positive effects of productivity growth are lost.

These three cases illustrate that the key to maintaining adequate employment growth is not productivity, but appropriate pricing of output and labour input. Additional workers will only be hired if they add more to sales than to costs. Additional sales can only be made if output can be priced more aggressively. Productivity growth provides the opportunity to increase our standard of living. It only destroys jobs if prices and wages do not play their proper roles in ensuring that jobs can be found for all who want to work.

1. INTRODUCTION

Advances in microelectronics, communications technology, and other technologies have started to increase production efficiency of our manufacturing and services sectors. Fewer workers will be required to produce a given level of output. One can easily find examples in particular situations of job losses that can be attributed to introduction of new production technology. Does this mean that an improvement in aggregate productivity will lead to reduced levels of employment?

Past experience with productivity growth is our most reliable guide to its future impact. It is possible to reject this notion, and build all kinds of theories about the future that assume no link to the past, but that becomes something more akin to a cult experience based on faith, instead of a rational analysis. Productivity growth may have taken different forms in different periods of our history, but the ultimate effects on the economy have been very similar.

Unless we wish to argue that the current situation is completely different from anything we have experienced before, improved productivity will have little long-term impact on the level of total employment. Productivity growth allows us to produce more goods and services with a given work force. This in contrast to a common view which argues that because of higher productivity, fewer workers will be required to produce a level of output that does not vary with the increase in efficiency.

To motivate our interpretation, we start with the observation that problems with high unemployment over the last decade coincide with lack of productivity growth, and not its acceleration. It is therefore somewhat incongruous to look at a future in which we expect to increase productivity significantly, and to infer that disappointing labour market conditions will continue indefinitely, by extrapolating from our immediate low-productivity past.

It would be more reasonable to argue that our problems with productivity stem from the fact that most of our Far Eastern competitors consistently manage to generate more of it than we do. Because of advances in communications and transportation, part of our standard of living is at risk

because producers are able to seek out locations where investment can be combined with low cost labour. It does not follow that even more jobs would be lost if we were to generate more productivity ourselves.

Before 1975, consistent productivity improvements were the norm in Canada. In fact, annual reductions in unit labour requirements exceeded those likely to be experienced over the next ten years. Hence, we are facing a problem which does not differ in nature or magnitude from what we have experienced before. It would seem reasonable to assume that this period of our history can also be a guide to some of the consequences of productivity growth.

Past increases in productivity were not coincident with job losses, but with real income increases. The simplistic view of productivity growth assumes that when productivity goes up, employment and wage income go down. If that were the whole story, we would observe a consistent decline in the share of labour income in Gross National Product. In fact, the share of labour income in GNP has shown a tendency to go up over the last 25 years, and the share of labour income in manufacturing value added has remained roughly constant.

This result can be explained by the tendency of relative prices to decline when cost pressures are alleviated by increased productivity. This increases competitiveness, sales and profits. When profits go up, demands for wage increases are usually not far behind. A combination of price reductions and wage increases typically creates enough additional real purchasing power in the economy to absorb workers that are made redundant.

Productivity growth, in absolute terms and relative to our competition, is the only way of generating increases in real wages and our standard of living. If the prospect of high productivity growth is considered depressing because of its alleged impact on employment, one cannot simultaneously deplore absence of increases in real incomes. One needs the first to get the second. With productivity growth, we may have a distribution problem. Without it, we have an income problem.

In section 2 our views on the relationships between productivity, employment and standards of living are contrasted with other views on these topics.

In section 3, we review the long-term outlook for Canada and Ontario. This outlook serves as the "base case" for our experiments.

In section 4 we describe the design of three projections of a "higher productivity future," including policy assumptions, and three sets of assumptions about the distribution of the productivity dividend.

Next, we analyze the differences from the base case with the aid of the Chase model of the Canadian and provincial economies. The model is an algebraic summary of "rules of thumb" about production relationships and behavioural responses to changes in income and prices. One of its main virtues is the ability to take into account a larger set of factors than can be considered without it. One can introduce deviations from historical behaviour where appropriate, and assume values for some phenomena (such as the rate of productivity growth), which are not directly explained. The model also provides a quick way of calculating differences from base projection upon introduction of alternative assumptions, in this case higher productivity growth under alternative assumption about wage and price behaviour.

Section 5 summarizes our findings and lists some of the signs pointing to satisfactory responses to productivity growth.

2. PRODUCTIVITY GROWTH: PRODUCING MORE OR WORKING LESS

Our views on the impact of productivity growth are reflected in the structure of the Chase model. These views imply a link between productivity and higher real incomes. The alternative view suggests a link between productivity and unemployment.

Many assertions about the employment effects of productivity growth do not take into account all factors relevant to corporate and personal decision-making. The arguments are often partial: they start with some observed change in a sub-sector of the economy, and generalize from there to what must be true for the aggregate. A review of some common premises is useful to pinpoint the source of differences with our own conclusions about the impact of productivity.

2.1 Premise:

The Rate of Increase in Productivity Growth Associated with New Technologies is about to Speed up Dramatically. It will Present us with Adjustment Problems of Unprecedented Magnitude.

The consensus view of the future among forecasters does not bear out this scenario. Most forecasts for the next ten years call for only about 2.5 to 3 percent real GNP growth. That implies an increase in output per worker of less than 1 percent a year, given that employment is likely to expand about 2 percent a year.

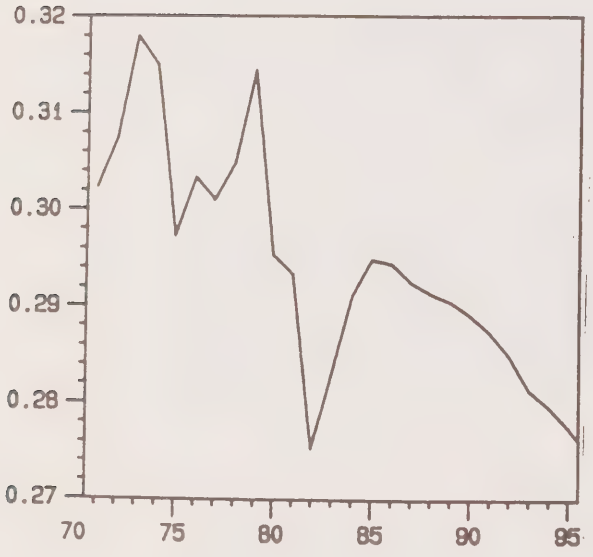
Labour productivity growth was very impressive in the fifties, and slowed down in the sixties and early seventies. Since 1978, it has been non-existent until then end of the 1982 recession. Before then, increases in output per worker averaged more than 2 percent a year.

Keeping in mind the slowdown over time, the statistics are nevertheless impressive. Between 1946 and 1982, output in commercial non- agricultural goods-producing industries increased about 5% per year. Output per manhour grew on average 4%. Output growth in the commercial service sector averaged 5.1% per year; output per manhour increased 2.2%.

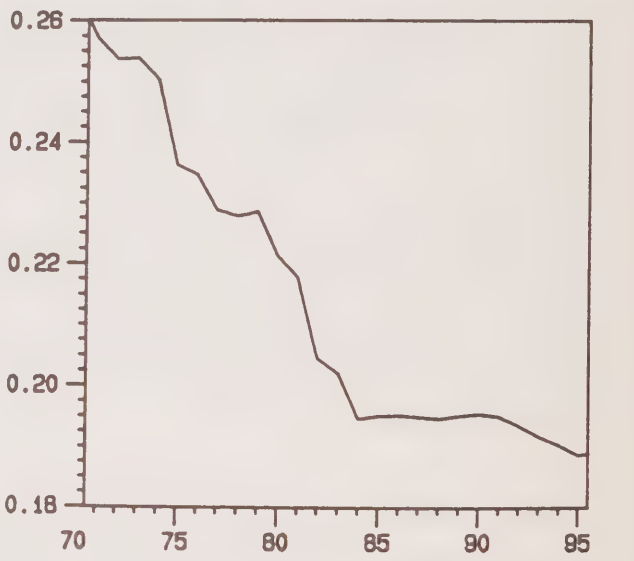
The implications of the differential in productivity growth for employment growth were dramatic: hours worked in goods producing industries grew only 1% per year on average. In services, the annual number of manhours worked grew by 2.9%. There is no evidence that shifts of this magnitude caused unemployment, until productivity growth started to slow down, and expectations of income growth did not adjust accordingly. Unemployment rates have been ratcheting up with the slowdown in productivity.

The important point is that shifts in composition of output and associated changes in the importance of employment in various industries have been the rule, rather than the exception.

RATIO OF ONTARIO MANUFACTURING
TO ONTARIO GDP



EMPLOYMENT IN ONTARIO
MANUFACTURING RELATIVE TO ONTARIO EMPLOYMENT



What could explain the gap between the popular perception of imminent and rapid change, and the more modest reality? It is possible, of course, that forecasts of both growth and productivity are too low. However, the problem probably lies in our lack of perspective in generalizing specific changes to the economy in general.

In most industries, one can identify a gap of perhaps as much as 30 percent between actual production conditions and ideal production conditions, using the latest technology, the latest organizational techniques, and the most efficient sources of energy. Adjustment from the current state to the ideal will take time, perhaps as much as 15 years. It also takes money and determination to get better results. Both are in short supply.

The part of productivity growth we can visualize tends to suggest an even greater potential improvement. Robot welders, automatic bank tellers, computerized housing inventories in real estate, and the mind-boggling rates of change in performance of products from the high-technology sector all conjure up an impression of enormous and immediate impact.

In fact, these forces are being introduced over a number of years. They tend to affect a relatively small part of the production effort in the relevant industries. When the large impact on a small sub-sector is spread over time, the numerical improvement in productivity is substantial, but not spectacular.

Conclusion: we have quite a way to go before we reach a situation where productivity growth becomes so strong that dislocation of workers due to technology becomes more of a factor than it was in the fifties and sixties.

2.2 Premise:

The Nature of the Technology and the Abrupt Change to Which it Gives Rise Make Historical Evidence on Productivity Next to Useless.

That argument has probably been used for the last 30 centuries with only minor variations. At the time it probably always seems that way, but while the source of the productivity growth usually represents a discontinuity with the past of some sort, the over-all effects tend to be the same: an increased standard of living for the economy as a whole.

Established industries always tend to be disrupted by new ones. The carriage industry did not do so well after the automobile came in. Canal transportation went into precipitous decline when railroads were built. Assembly times went down by several orders of magnitude when Ford intruduced the assembly line. Printing undoubtedly put a lot of scribes out of work. Slide rule manufacturers lost their market nearly overnight with the introduction of electronic calculators.

However, adjustment problems aside, any successful invention eventually ends up doing two things: increase labour productivity and creating or expanding markets, because of increased performance relative to price. Some jobs are lost, others replace them. We know of no major example of an economy that does not respond in this fashion, unless prevented from doing so by lack of flexibility in labour and capital markets.

2.3 **Premise:**

Our Current Technological Dilemma Is Unique Because we Stand on the Verge of Making Work as We Know It Obsolete.

Malthus would have sympathized with the miscalculation in timing in this one. He predicted that population growth would soon outrun the ability of agriculture to sustain it. So far he has been proven wrong, because agriculture is our most productive industry.

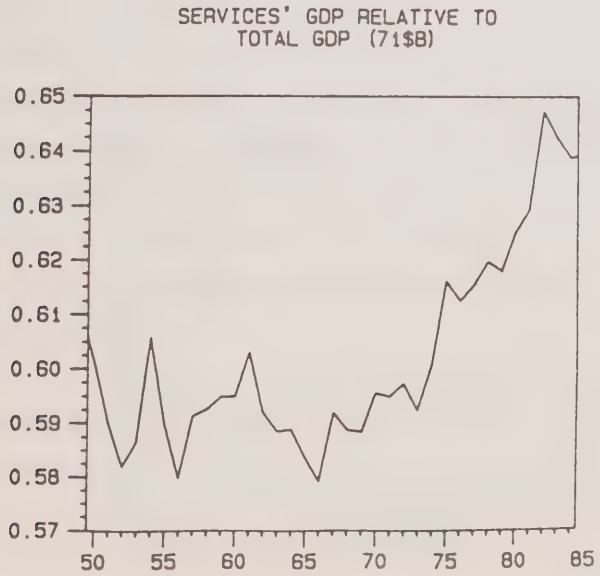
Similarly, we are on very slippery ground when we assume that our capacity to produce will soon be so high that workers will be superfluous. If work is soon to become obsolete, why do most of us feel in no immediate danger of joining the idle rich?

Most of us have no trouble visualizing the spending of an additional $10,000 or $20,000 per year. So clearly we have not yet reached the stage where all our material wants have been satisfied. Since the larger of these amounts roughly represents per capita income in Canada, it may be some time (at least 25 years) before we all earn an extra $20,000 in 1985 dollars. If history is any indication, we will have come up with some new spending ideas by then.

2.4 Premise:

The Service Sector Will Never Be Able to Absorb the Flood of Workers Entering the Labour Market. There are Limits to the Level of Services People are Willing to Buy.

If we have not reached the stage yet where we cannot think of things to spend our money on, it is very unlikely that we will collectively deviate from our long-standing tendency to spend a stable share on services. Because of the labour intensity of this sector, employment will increase correspondingly. The problem here appears to be our inability to visualize services beyond restaurants, transportation, household help, and medical care. As indicated in the graph below, the service sector continues to increase its share of total production (abstracting from business sector fluctuations).

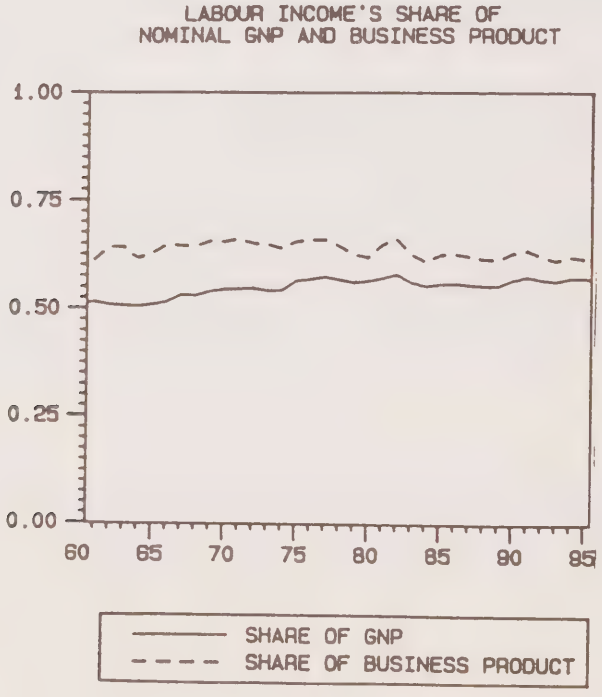


2.5 Premise:

When Productivity Goes Up, Fewer People are Required to Produce What was Produced Before, and Unemployment Will Result.

If the only effect of productivity growth were a reduction in labour input to achieve the same level of production, we would observe a shift in the income distribution over time: the share of wages in business product would decline consistently. If production fetches the same unit price as before, and less labour is required to produce it, the difference has to show up in profits.

However, productivity per manhour in manufacturing has more than doubled in the postwar period and the share of labour income in value added has remained about the same, on average. It tends to rise near the bottom of a business cycle, and fall during a business cycle upswing. Results are not much different for the share of wages in commercial business product. The share of wages in GNP has in fact shown a tendency to increase over time, from around 50% in the sixties to about 55% recently.



But that poses another problem. We observed no serious unemployment problems in Canada until the mid-seventies. Thus, if labour shares in productivity gains, as appears to be the case, and if those gains are substantial, and if we nevertheless want to hold to the view that productivity makes labour redundant, we should have seen a far more dramatic reduction in work week length than the 1.5-2% per year actually observed. There also would have been no increase in real wages, because if production does not increase when productivity does, there is no additional output to distribute.

In our view, this indicates the validity of the standard economists' view that the ability of the economy to grow on a consistent basis ("potential growth") increases directly with the level of productivity. Potential growth will only remain unchanged if the number of hours people want to work starts to fall more than proportionally to the productivity increase.

It is reasonable to assume that the workweek declines and some people decide to voluntarily lower their work effort because they can afford to, as the average standard of living increases. It is more difficult to envisage this result when output and income remain unchanged.

One of the mechanisms by which this result comes about is through a reduction of prices for products experiencing improvements lower unit production costs. Individual firms can gain an advantage by sharing superior cost performance with their customers. Just like productivity growth in agriculture reduced the proportion of income required to meet requirements for food, so have reductions in the cost of manufactured goods reduced the cost of purchasing these items. We tend to respond to price reductions in two ways: we may purchase more of the good that has declined in price, or we can take the real income increase resulting from being able to obtain our previous purchases at the lower price and spend it on other goods and services.

It turns out that while the reduction in unit labour requirements is the easiest to understand, the effects that have worked in the opposite direction are far more diffuse. When 500 jobs are lost due to improved

productivity in one facility, it will generate headlines. It is hard to get journalists excited about the balancing creation of a similar number of jobs in 500 or more product lines due to a re-allocation of expenditures.

The statistical evidence suggests that productivity growth typically leads to output expansion, not to the labour input reduction. Without that link, we would not be able to explain the close relationship between real wages and productivity growth.

2.6 **Premise:**

Many Workers Will Become Technologically Obsolete and the Prospects of Finding New Jobs are Small. This May Eliminate the Income Gains from Productivity and Cause Serious Social Problems.

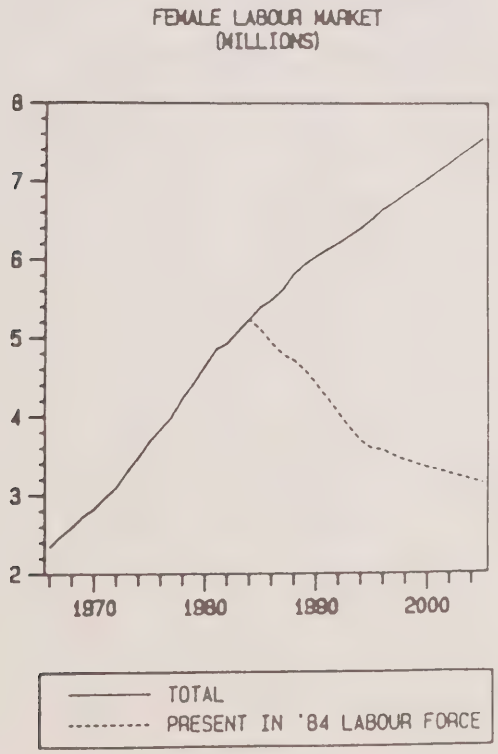
This may become a real problem in one-company towns, or areas depending on a single declining industry. A similar argument has been used with respect to "job-ghettos" for women. We fully agree that this is probably the thorniest of all productivity issues. But it is not new. As indicated earlier, the rate of change in composition of employment and production is likely to be gradual.

A sense of fairness would suggest that public policy be used to facilitate labour mobility. We see the problem primarily arising in terms of age: it will be difficult to retrain those over 50. However, we cannot be too inflexible . Younger workers cannot expect to remain in a single job or industry for their working lives. We should condition ourselves to retrain and move on to new pursuits several times during our working lives.

As an interim measure, we should remove obstacles now existing to part-time employment. Some employers are using part-time labour because it is cheaper. In a stagnating industry that raises questions about the appropriateness of wage levels. However, in some cases, employers prefer

full-time workers because of real or perceived disadvantages of part-time workers from a standpoint of administration or productivity. It strikes us that one should take a hard look at these disadvantages. They might turn out to be minimal. We expect that many large organizations will find that their ability to increase sales will be less than their scope for productivity growth. Some workers might prefer part-time employment when offered the choice.

We should not exaggerate built-in rigidities. Our capacity to adjust can be illustrated in the context of the argument sometimes made about employability of women. If women tend to go into jobs that face an increasingly dim future, female unemployment will of necessity rise over time. This argument assumes a degree of rigidity that just does not make sense. Males and females have adjusted their career planning over the last 25 years in response to the job market. Why should they be incapable of doing so again in the future? It is known with some degree of certainty that jobs will not be available in contracting sectors, you head towards one where employment is expanding.



The freedom of choice to do so can be illustrated for women by a graphic comparison of the female labour force over the next 20 years with individuals currently included in the female labour force. The difference between the two lines represents women who as of this date still have all their options open. It would be insulting to assume that they would head for positions that are non-existent.

2.7 **Premise:**

Our Future is Dim Since We Have Difficulty Matching Low Cost Labour Countries.

We cannot fix that problem by giving up on productivity growth. International and Canadian evidence suggests that the choice will be between doing nothing and losing big, or improving productivity in defensible product lines and preserving those markets. None of this is new. But it has become a more serious problem since our average productivity growth has dropped faster than that of our competitors.

Productivity Growth

(annual average percentage change)

	Trend	deceleration from trend	
	1962-72	1973-78	1978-82
United States	1.9	1.6	2.1
Japan	8.5	5.8	5.8
West Germany	4.5	1.3	3.1
France	4.7	2.0	2.8
Britain	3.0	1.7	1.2
Italy	5.5	4.3	3.9
Canada	2.7	2.0	4.0
Total	**3.9**	**2.5**	**3.0**

Canada

1971-75	1978	1979	1980	1981	1982
1.7	-0.2	-0.2	-2.8	0.0	-2.8

Source: OECD Economic outlook, December 1982

We should keep in mind that wage levels alone exaggerate our disadvantage. Proximity still accounts for something. Labour productivity is not the same everywhere. Even so, it is true that we might lose out in such areas as textiles and shoes, and will find Mexico and Brazil formidable competitors in autoparts.

Part of the problem may have to be resolved by holding the line on real wages. If we accept the real wage increases resulting from a buoyant industry, we have to accept that declining industry fortunes may warrant little real wage increases.

It is undoubtedly true that we are losing out in sectors in which trade was until recently mostly with other high-wage countries. It may be true that increases in foreign productivity and lower wages have made us more vulnerable in certain markets. If we are going to respond to this challenge it will have to be by saving as many jobs as possible by increasing productivity ourselves.

Ontario Employment in Thousands
Base Case Projection

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
AGRICULTURE	136.0	136.0	136.0	136.0	136.0	136.0	136.0	136.0	136.0	136.0	136.0
FISH., TRAP.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FORESTRY	10.7	11.0	11.5	12.0	12.4	12.5	12.6	12.5	12.5	12.5	12.5
MINING	32.5	32.6	32.7	33.5	34.5	35.7	36.5	37.0	37.5	38.4	39.0
FOOD, BEV.	95.7	97.7	99.8	102.5	105.9	109.8	111.8	112.5	113.0	114.4	115.1
TOBACCO	4.2	4.4	4.7	4.9	4.9	5.0	5.0	4.9	4.9	4.9	4.9
RUBBER, PLAST.	42.2	42.9	43.7	44.8	45.8	47.2	47.4	47.1	47.4	47.8	48.0
LEATHER	15.1	15.4	15.7	16.1	16.5	16.9	17.1	17.0	17.0	17.1	17.1
TEXTILES	30.5	31.0	31.6	32.3	33.6	34.5	35.1	35.2	35.3	35.6	35.7
CLOTHING	36.6	37.0	37.7	38.2	39.4	40.7	41.0	41.1	41.4	42.5	42.6
KNITTING	3.5	3.6	3.7	3.7	3.6	3.7	3.6	3.5	3.5	3.5	3.5
PAPER	47.2	48.4	49.0	49.9	51.4	52.8	53.7	54.1	54.4	55.0	55.2
WOOD	21.0	21.5	21.4	21.5	22.3	23.2	23.8	24.0	24.1	24.4	24.7
FURNITURE	31.5	32.1	32.8	33.6	34.3	35.1	35.6	35.9	36.0	36.3	36.5
PETROL., COAL	10.9	11.1	11.3	11.5	11.6	11.8	11.8	11.7	11.7	11.6	11.6
PRIMARY MET.	66.3	67.5	68.6	70.3	71.9	73.2	74.0	74.1	74.2	74.8	75.1
METAL FAB.	85.6	87.5	89.4	91.7	94.4	97.2	98.4	99.0	99.6	100.7	101.5
MACHINERY	70.3	71.4	72.7	74.5	76.1	77.5	78.3	78.9	79.4	80.3	80.7
ELECTRICAL	90.8	92.5	94.6	96.8	99.5	102.3	103.8	104.3	104.7	105.7	106.4
PRINT., PUB.	73.8	75.2	76.8	78.5	80.9	83.2	84.6	84.8	85.3	86.4	86.5
NON-MET. MIN.	28.0	28.3	28.9	29.7	30.7	31.7	31.9	32.0	32.0	32.3	32.4
CHEMICALS	46.4	47.5	48.0	49.2	50.5	51.5	52.4	52.5	51.8	51.1	50.4
TRANS. EQ.	137.3	140.4	143.5	147.2	151.9	155.8	156.5	157.3	158.0	159.5	160.2
MISC. MFG.	42.4	42.9	43.8	44.8	45.9	46.9	47.4	47.5	47.6	47.9	48.0
MANUFACTURING	979.4	998.2	1017.7	1041.7	1071.1	1099.8	1113.2	1117.6	1121.2	1131.8	1136.1
CONSTRUCTION	232.4	235.4	238.6	242.1	246.4	251.4	254.3	255.7	257.0	260.0	261.7
TRANSPORTATION	157.9	160.7	162.9	167.3	172.9	178.5	181.7	182.2	183.8	187.0	189.1
COMMUNICATIONS	95.9	98.0	100.2	102.0	104.4	107.2	108.9	109.9	110.9	112.6	113.8
STORAGE	6.2	6.3	6.4	6.6	6.7	6.9	7.0	7.1	7.1	7.2	7.3
UTILITIES	48.2	49.0	49.3	50.1	51.0	53.9	56.1	58.3	59.3	61.9	64.8
TRANS.,COMM., AND UTIL.	308.3	314.0	318.8	325.9	335.1	346.5	353.8	357.4	361.0	368.8	375.0
TRADE	704.7	720.5	733.7	750.9	769.9	790.9	805.3	814.5	822.4	837.4	845.8
FIN.,INS., AND R.E.	278.0	280.3	285.6	293.4	302.8	314.0	321.0	326.0	330.4	337.8	342.9
SERVICES	1374.2	1408.8	1451.9	1501.7	1553.9	1598.9	1634.2	1676.0	1722.6	1767.2	1810.0
PUBLIC ADMIN.	282.6	289.8	296.4	303.1	309.1	315.8	320.9	324.2	327.6	333.5	337.8
TOTAL EMPLOYMENT	4338.8	4426.5	4523.0	4640.4	4771.1	4901.6	4987.9	5057.0	5128.3	5223.3	5296.7

3. BASE PROJECTION: SUB-OPTIMAL GROWTH

Many Canadians are concerned that their standard of living will not increase significantly in the future. Some even fear that technological developments in the eighties and nineties may generate mass unemployment. We consider such a dismal outcome unlikely but expect that this lack of confidence in the extent and durability of economic expansion will leave many opportunities unexploited.

BASE PROJECTION FOR CANADA AND ONTARIO
Average Annual Growth Rates 1985-95

	Canada	Ontario
GNP,GDP	2.7%	2.9%
CPI	5%	5%
Employment Growth	1.9%	2.0%
Labour Force Growth	1.3%	1.5%
Labour Productivity	.8%	.9%

Interest Rate - Prime	declining from 11.8% in 1985 to 9.1% in 1995.
Unemployment Rate	declining from 10.9% in 1985 to 5.8% in 1995.

The Chase base case used in this analysis projects Canadian GNP real growth to average 2.5-3% over the next decade. Despite an annual rate of increase a little less than 1% in productivity, increases in real disposable income per worker will likely be small, since taxes will have to rise faster than income to reduce public sector deficits. Moderate growth, an average rate of labour force expansion of about 1.5% per annum, and continued increases in the participation rate, imply that unemployment will decline only slowly. Investment will be relatively weak, partly because growth is weak, and partly because real interest rates are projected to remain high by historical standards.

The external environment forecast is very similar to the one in Canada: U.S. economic growth averages about 3%, and U.S. price inflation averages a shade under 5%.

The key to faster low-inflation growth than projected in our standard forecast is a more rapid pace of modernization of Canadian manufacturing, since this sector offers the best opportunities for productivity improvement. Increasing productivity requires substantially larger investments than are currently planned, and a fairly significant reallocation of employment between industries. High investment and high labour mobility are more likely to be stimulated by robust growth. However, many manufacturing industries are facing mature or declining markets and have substantial excess capacity.

Canada's short-run problem consists of generating enough additional activity to remove some of the doubts about the ability of the economy to grow on a sustained basis. Improved confidence backed up by sales statistics will then make it easier to justify additional investment spending, which is absolutely necessary to keep inflation rates at or below international levels.

Because of large public sector deficits and widespread concern about the growth of the public sector, additional government stimulus over a long period would be impractical. Furthermore, there are few industries in the private sector that are able to finance ventures of sufficient size to serve as "engines of growth."

Canada has traditionally looked to a resource sector boom driven by external demand to get itself out of this kind of growth impasse. However, the outlook for most resource prices is not as bullish as was once thought, due to increased international competition and reduced intensity of resource use. Indeed, a key resource activity, energy, is expected (under a continuation of existing government policies) to be a source of weakness in the immediate future. Lower projected rates of increase in demand for electrical energy have caused most utilities to scale down projected spending. Coal is not quite the growth sector it once was thought to be. Spending on oil and gas exploration and production have been hit by reduced prospects for oil and gas prices. Reversal of previous energy pricing and taxation policies will take some time to make a big difference.

Overall, our base case forecast depicts a less than optimum view of Canada's economic future.

4. THE EXPERIMENT: 5% MORE PRODUCTIVITY BETWEEN NOW AND 1995

4.1 Changes To Productivity

How would the Canadian and Ontario economies change relative to our current "most likely" projection, if we could accelerate the rate of productivity by .5% per year? For simplicity, let us assume that all sectors are equally capable of generating this improvement in productivity, so that relative productivity across industrial sectors is unaffected. We also assume that the external economy does not change its operating efficiency. We are improving our relative international position.

The magnitude of the change is small. If we accept that inertia is the most dynamic force in most organizations, a concerted effort to focus on improving operating procedures could easily yield this amount of change. For example, reading recent reports by Falconbridge and Inco on double-digit improvements in productivity in a few years time, one wonders why it was possible to do so much in so little time now, and not earlier. The answer probably lies in our collective tendency to avoid change unless it becomes absolutely unavoidable. Taken in that context, an extra 5% in 10 years is not a very tall order.

We are not saying that equal rates of productivity growth are likely to occur in Canada over the next 10 years. In fact, our base projections assume that manufacturing will find it easier to generate efficiency increases than , for instance, the service sector. To some extent this reflects the way we measure things. Statistics Canada sometimes has to measure output by estimating labour input. This makes it somewhat difficult to show productivity growth. Our assumption of equal rates of increase in productivity at the margin was made mostly to avoid argument over any number of other formulas which are no less arbitrary.

To implement our experiment, we increased our measures of total factor productivity for each sector. This is a concept comparable to output per worker, except that it takes into account variations in capital-labour mix, and differences in the share of wages in value added for various industries. For the sake of simplicity, we will talk mostly about changes in labour productivity, defined as 1971 dollar output per worker.

4.2 Supporting Policy Assumptions

We assumed that gradual reduction of federal and provincial deficits is the policy goal of both levels of governments. We expressed these goals in terms of percentages of GNP. Variations in the deficit between our base case and the high productivity case where assumed to result in changes in personal income taxes and therefore in disposable income. Not making an asumption of this kind amounts to changing the size of the government sector, which we felt to be inappropriate.

Whenever Canadian productivity improvement was reflected in improved price competitiveness, we assumed that any tendency of the exchange rate to improve would be partially offset by the Bank of Canada through a reduction in interest rates. Specifically, in case 1 below, all rates were reduced by 50 basis points.

4.3 Behavioural Responses to Increased Productivity

We consider three cases, each with a different set of assumptions about the nature of the process that determines wages and prices.

The productivity and policy assumptions outlined in 4.1 and 4.2 were paired with three sets of assumptions about price and wage formation. Case 1 describes a response which is basically competitive. Case 2 assumes market power on the part of producers to increase profits relative to wages. Case 3 assumes the reverse: the ability of workers to increase their share of GNP relative to profits.

4.4 Case 1 - High Growth - High Employment

Assumes that the market is, on the whole, competitive. The distribution of income between wages and returns to investors is dictated by what is reasonable from the standpoint of competitiveness and rate of return on capital. Neither workers nor producers have the market power to increase their relative position. The labour market is not fully competitive: the starting position of 11% unemployment suggests that as the existing levels of productivity and wages, not everyone can be productively employed. However, we assume that the increase in productivity does not result in an increase in real wages until employers have created enough jobs at the real wage incorporated in the base case to bring the unemployment rate down to about 5%. When that level is reached we reverted to the behaviour observed in the fifties and sixties: increasing productivity results in increased real wages. Our assumption will yield the maximum change in real GNP that can be expected if workers opt not to take part of this increase in the form of leisure, as they did during previous periods of high productivity growth.

A comparison of Case 1 with the base case is provided on the next two pages. Total employment in Ontario is higher than in the base case, particularly in the 1986-1992 period, when the slack in the labour market is highest in the base case. At its peak, employment is nearly 2% higher than in the base case.

The increases in real disposable income that result from the higher levels of employment and productivity do not produce uniform impact on foreign and domestic demand. Higher income and lower levels of interest rates stimulate car sales and housing starts, and thereby the construction sector. Construction is also buoyed by higher levels of investment expenditures. More of the income increases are spent on services than on goods. Spending on goods tends to be concentrated in the durables categories. This is reflected in the differential impacts on employment by industry.

Case 1 High Growth - High Employment
Ontario Employment in Thousands
Level Difference from Base Case Projection

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
AGRICULTURE	0.1	0.3	0.4	0.5	-0.2	-1.5	-2.9	-4.2	-5.5	-6.8	-8.1
FISH., TRAP.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FORESTRY	0.0	0.0	0.0	-0.1	-0.1	-0.2	-0.4	-0.4	-0.5	-0.5	-0.6
MINING	0.0	0.2	0.2	0.3	0.4	0.1	-0.3	-0.5	-0.8	-1.1	-1.4
FOOD, BEV.	-0.3	-0.3	-0.1	0.0	0.3	-0.6	-1.1	-1.0	-1.4	-1.6	-1.7
TOBACCO	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.2	-0.2
RUBBER, PLAST.	-0.1	-0.2	-0.1	0.0	0.0	-0.3	-0.6	-0.5	-0.7	-0.8	-0.9
LEATHER	-0.1	-0.1	0.0	0.0	0.0	-0.1	-0.2	-0.2	-0.3	-0.4	-0.4
TEXTILES	-0.1	-0.1	-0.1	0.0	0.0	-0.3	-0.6	-0.5	-0.7	-0.8	-0.8
CLOTHING	-0.1	-0.1	0.0	0.1	0.2	0.1	-0.2	-0.2	-0.3	-0.5	-0.5
KNITTING	0.0	-0.1	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.1	-0.2	-0.2
PAPER	-0.2	-0.2	-0.1	0.0	0.2	-0.2	-0.4	-0.3	-0.5	-0.7	-0.7
WOOD	-0.1	-0.2	-0.2	-0.1	0.1	-0.1	-0.1	-0.1	-0.2	-0.2	-0.3
FURNITURE	-0.1	-0.1	0.0	0.1	0.1	-0.2	-0.4	-0.4	-0.5	-0.6	-0.6
PETROL., COAL	0.0	-0.1	-0.1	0.0	-0.1	-0.2	-0.3	-0.2	-0.3	-0.3	-0.4
PRIMARY MET.	-0.2	-0.3	-0.3	-0.2	-0.2	-0.8	-1.2	-1.1	-1.4	-1.6	-1.7
METAL FAB.	-0.3	-0.4	-0.3	-0.1	-0.1	-0.8	-1.4	-1.3	-1.7	-1.9	-2.1
MACHINERY	-0.1	0.0	0.2	0.4	0.5	-0.1	-0.7	-0.7	-1.0	-1.2	-1.3
ELECTRICAL	-0.2	-0.2	0.0	0.1	0.2	-0.5	-1.1	-1.0	-1.3	-1.5	-1.6
PRINT., PUB.	-0.2	-0.2	-0.1	0.0	0.2	-0.5	-1.0	-0.9	-1.2	-1.4	-1.5
NON-MET. MIN.	-0.1	-0.1	-0.1	0.0	0.0	-0.2	-0.4	-0.4	-0.5	-0.6	-0.6
CHEMICALS	-0.2	-0.2	-0.2	-0.2	-0.3	-0.7	-1.1	-1.0	-1.2	-1.3	-1.4
TRANS. EQ.	-0.5	-0.8	-0.7	-0.4	0.5	-0.5	-1.1	-1.0	-1.8	-2.3	-2.7
MISC. MFG.	-0.2	-0.2	-0.2	-0.1	-0.1	-0.4	-0.7	-0.6	-0.8	-0.9	-0.9
MANUFACTURING	-3.2	-3.8	-2.4	-0.4	1.7	-6.6	-12.8	-11.7	-16.0	-18.8	-20.4
CONSTRUCTION	0.5	3.7	6.4	7.8	9.0	6.8	4.8	4.1	2.7	2.1	2.0
TRANSPORTATION	-0.3	0.0	0.8	1.7	2.2	1.0	-0.1	-0.1	-0.9	-1.3	-1.5
COMMUNICATIONS	-0.3	0.0	0.6	1.3	1.7	1.0	0.5	0.8	0.7	0.9	1.1
STORAGE	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.1	-0.2
UTILITIES	-0.2	-0.1	0.5	1.0	1.4	1.1	0.4	0.1	-0.6	-1.2	-1.6
TRANS.,COMM., AND UTIL.	-0.9	-0.1	1.9	3.9	5.4	3.1	0.7	0.7	-0.9	-1.8	-2.1
TRADE	0.0	5.4	12.6	19.2	25.2	20.1	14.0	14.1	11.2	10.1	11.1
FIN.,INS., AND R.E.	-0.3	0.7	2.8	5.2	6.7	4.8	2.8	2.8	1.3	0.6	0.1
SERVICES	6.3	16.3	20.7	26.7	37.5	31.7	28.8	20.0	23.7	28.2	28.4
PUBLIC ADMIN.	-1.4	-0.8	-0.1	0.9	1.2	-0.7	-2.0	-1.0	-1.2	-1.0	-0.5
TOTAL EMPLOYMENT	1.1	21.6	42.5	64.1	86.7	57.5	32.7	24.0	14.0	10.9	8.5

Case 1 High Growth - High Employment
Ontario Employment
Percent Difference from Base Case Projection

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
AGRICULTURE	0.1	0.2	0.3	0.4	-0.1	-1.1	-2.1	-3.1	-4.0	-5.0	-5.9
FISH., TRAP.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FORESTRY	-0.4	-0.4	-0.3	-0.4	-0.7	-1.9	-2.9	-3.1	-3.7	-4.2	-4.5
MINING	0.2	0.5	0.8	0.9	1.0	0.2	-0.9	-1.3	-2.1	-2.8	-3.5
FOOD, BEV.	-0.3	-0.3	-0.1	0.0	0.3	-0.5	-1.0	-0.9	-1.2	-1.4	-1.5
TOBACCO	-0.4	-0.4	0.2	0.5	0.3	-1.0	-2.1	-2.3	-2.9	-3.2	-3.3
RUBBER, PLAST.	-0.3	-0.4	-0.2	0.0	0.1	-0.6	-1.2	-1.1	-1.5	-1.7	-1.8
LEATHER	-0.3	-0.4	-0.1	0.1	0.2	-0.7	-1.4	-1.4	-1.8	-2.1	-2.2
TEXTILES	-0.3	-0.4	-0.3	-0.1	-0.1	-0.9	-1.6	-1.5	-1.9	-2.1	-2.2
CLOTHING	-0.3	-0.4	0.0	0.4	0.6	0.2	-0.4	-0.4	-0.8	-1.1	-1.2
KNITTING	-0.9	-1.6	-1.1	-0.4	-0.3	-1.5	-2.8	-2.9	-4.0	-5.0	-5.5
PAPER	-0.4	-0.4	-0.2	0.0	0.4	-0.3	-0.8	-0.6	-1.0	-1.2	-1.3
WOOD	-0.4	-0.7	-0.7	-0.3	0.3	-0.3	-0.6	-0.5	-0.8	-0.9	-1.0
FURNITURE	-0.3	-0.2	0.0	0.2	0.4	-0.4	-1.1	-1.0	-1.4	-1.6	-1.7
PETROL., COAL	-0.5	-0.7	-0.5	-0.4	-0.4	-1.4	-2.2	-2.1	-2.6	-3.0	-3.1
PRIMARY MET.	-0.4	-0.5	-0.4	-0.3	-0.2	-1.0	-1.6	-1.5	-1.9	-2.1	-2.2
METAL FAB.	-0.3	-0.4	-0.3	-0.2	0.0	-0.8	-1.4	-1.3	-1.7	-1.9	-2.0
MACHINERY	-0.2	-0.1	0.2	0.5	0.6	-0.2	-0.8	-0.9	-1.3	-1.5	-1.6
ELECTRICAL	-0.3	-0.2	0.0	0.1	0.2	-0.5	-1.1	-0.9	-1.2	-1.4	-1.5
PRINT., PUB.	-0.3	-0.3	-0.1	0.1	0.2	-0.6	-1.2	-1.1	-1.4	-1.6	-1.8
NON-MET. MIN.	-0.3	-0.4	-0.3	-0.1	0.0	-0.8	-1.4	-1.3	-1.6	-1.8	-1.9
CHEMICALS	-0.3	-0.4	-0.4	-0.4	-0.5	-1.4	-2.1	-1.9	-2.3	-2.6	-2.7
TRANS. EQ.	-0.4	-0.5	-0.5	-0.2	0.4	-0.3	-0.7	-0.6	-1.1	-1.4	-1.7
MISC. MFG.	-0.4	-0.6	-0.4	-0.2	-0.1	-0.9	-1.5	-1.2	-1.6	-1.8	-1.9
MANUFACTURING	-0.3	-0.4	-0.2	0.0	0.2	-0.6	-1.1	-1.0	-1.4	-1.7	-1.8
CONSTRUCTION	0.2	1.6	2.7	3.2	3.6	2.7	1.9	1.6	1.0	0.8	0.8
TRANSPORTATION	-0.2	0.0	0.5	1.0	1.3	0.6	-0.1	-0.1	-0.5	-0.7	-0.8
COMMUNICATIONS	-0.3	0.0	0.6	1.2	1.7	0.9	0.5	0.8	0.7	0.8	1.0
STORAGE	-0.2	-0.1	0.2	0.4	0.4	-0.5	-1.3	-1.4	-1.8	-2.0	-2.2
UTILITIES	-0.4	-0.2	1.0	2.0	2.7	2.1	0.7	0.2	-1.2	-1.9	-2.5
TRANS.,COMM., AND UTIL.	-0.3	0.0	0.6	1.2	1.6	0.9	0.2	0.2	-0.3	-0.5	-0.6
TRADE	0.0	0.7	1.7	2.6	3.3	2.5	1.7	1.7	1.4	1.2	1.3
FIN.,INS., AND R.E.	-0.1	0.2	1.0	1.8	2.2	1.6	0.9	0.9	0.4	0.2	0.0
SERVICES	0.5	1.2	1.4	1.8	2.4	2.0	1.8	1.2	1.4	1.6	1.6
PUBLIC ADMIN.	-0.5	-0.3	0.0	0.3	0.4	-0.2	-0.6	-0.3	-0.4	-0.3	-0.2
TOTAL EMPLOYMENT	0.0	0.5	0.9	1.4	1.8	1.2	0.7	0.5	0.3	0.2	0.2

4.5 Case 2 - High Profits - Low Employment

The pessimistic view about a high productivity future typically assumes (explicitly or implicitly) that the "productivity dividend" goes entirely to increase profit margins. Producers have the power to shift the distribution of income dramatically in their favour. Case 2 is consistent with this presumption.

In our particular case, the share of profits would increase from 10% in 1985 to 15% in 1995. This would only be possible if producers were completely impervious to foreign and domestic competition. We have not observed such extreme behaviour in the past.

If all the gains go to profits, no improvement in price competitiveness results. Sales volumes do not increase. Fewer workers are required to produce the same level of output incorporated in the base case.

Unlike the previous case, the increase in GDP and GNP from the base case under these assumptions is less than 1% by 1995. The dominant effect is a reduction in employment required to produce essentially the same output as in the base projection. Differences in employment from the base case are found on the next two pages.

The re-distribution of income towards investors causes a somewhat different expenditure pattern in favour of investment goods and away from consumer goods. This is reflected in the composition of employment losses.

Case 2 High Profits - Low Employment
Ontario Employment in Thousands
Level Difference from Base Case Projection

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
AGRICULTURE	-0.3	-0.5	-0.8	-1.1	-1.4	-1.6	-1.9	-2.2	-2.4	-2.7	-3.0
FISH., TRAP.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FORESTRY	0.0	0.0	-0.1	-0.1	-0.1	-0.2	-0.2	-0.3	-0.3	-0.3	-0.3
MINING	-0.1	-0.1	-0.2	-0.2	-0.2	-0.2	-0.3	-0.5	-0.6	-0.7	-0.8
FOOD, BEV.	-0.2	-0.4	-0.5	-0.6	-0.7	-0.9	-1.2	-1.4	-1.4	-1.4	-1.5
TOBACCO	0.0	0.0	-0.1	-0.1	-0.1	-0.2	-0.2	-0.2	-0.2	-0.3	-0.3
RUBBER, PLAST.	-0.1	-0.2	-0.3	-0.4	-0.4	-0.6	-0.7	-0.8	-0.8	-0.9	-0.9
LEATHER	0.0	-0.1	-0.1	-0.2	-0.2	-0.3	-0.3	-0.4	-0.4	-0.4	-0.4
TEXTILES	-0.1	-0.2	-0.2	-0.3	-0.4	-0.4	-0.6	-0.6	-0.7	-0.7	-0.7
CLOTHING	-0.1	-0.2	-0.2	-0.2	-0.2	-0.4	-0.4	-0.4	-0.5	-0.5	-0.5
KNITTING	0.0	0.0	-0.1	-0.1	-0.1	-0.1	-0.2	-0.2	-0.2	-0.2	-0.2
PAPER	-0.1	-0.2	-0.3	-0.3	-0.3	-0.4	-0.5	-0.6	-0.6	-0.6	-0.6
WOOD	-0.1	-0.2	-0.2	-0.1	-0.1	-0.1	-0.1	-0.1	0.0	0.0	0.1
FURNITURE	-0.1	-0.2	-0.2	-0.3	-0.4	-0.5	-0.6	-0.7	-0.7	-0.8	-0.8
PETROL., COAL	0.0	-0.1	-0.1	-0.1	-0.1	-0.2	-0.2	-0.2	-0.2	-0.2	-0.3
PRIMARY MET.	-0.2	-0.4	-0.5	-0.6	-0.7	-0.8	-1.1	-1.2	-1.3	-1.3	-1.4
METAL FAB.	-0.2	-0.4	-0.6	-0.7	-0.8	-1.1	-1.3	-1.5	-1.6	-1.6	-1.7
MACHINERY	-0.1	-0.3	-0.4	-0.5	-0.7	-0.8	-1.0	-1.2	-1.2	-1.3	-1.3
ELECTRICAL	-0.2	-0.4	-0.6	-0.7	-0.9	-1.2	-1.5	-1.8	-1.9	-1.9	-2.0
PRINT., PUB.	-0.2	-0.4	-0.5	-0.6	-0.8	-0.9	-1.2	-1.4	-1.4	-1.5	-1.5
NON-MET. MIN.	-0.1	-0.2	-0.2	-0.3	-0.4	-0.4	-0.5	-0.6	-0.6	-0.7	-0.7
CHEMICALS	-0.1	-0.3	-0.4	-0.4	-0.5	-0.6	-0.8	-0.9	-0.9	-1.0	-1.0
TRANS. EQ.	-0.3	-0.6	-0.6	-0.7	-0.9	-1.1	-1.4	-1.5	-1.6	-1.7	-1.8
MISC. MFG.	-0.1	-0.3	-0.4	-0.5	-0.6	-0.7	-0.8	-1.0	-1.0	-1.1	-1.1
MANUFACTURING	-2.2	-5.0	-6.3	-7.6	-9.3	-11.7	-14.8	-16.6	-17.4	-17.9	-18.8
CONSTRUCTION	0.0	0.4	-0.4	-1.7	-2.9	-3.5	-4.1	-4.6	-5.2	-5.2	-4.7
TRANSPORTATION	-0.4	-0.9	-1.2	-1.7	-2.3	-3.1	-3.8	-4.4	-4.8	-5.2	-5.5
COMMUNICATIONS	-0.3	-0.7	-0.9	-1.2	-1.7	-2.2	-2.7	-3.0	-3.4	-3.7	-3.8
STORAGE	0.0	0.0	-0.1	-0.1	-0.1	-0.1	-0.1	-0.2	-0.2	-0.2	-0.2
UTILITIES	-0.3	-0.8	-1.2	-1.7	-2.3	-2.8	-3.3	-3.8	-4.4	-4.9	-5.4
TRANS.,COMM., AND UTIL.	-1.0	-2.4	-3.4	-4.7	-6.4	-8.2	-9.9	-11.4	-12.8	-14.0	-15.0
TRADE	-1.6	-3.9	-6.8	-10.5	-14.6	-18.0	-21.0	-23.7	-26.2	-27.9	-28.2
FIN.,INS., AND R.E.	-0.6	-1.9	-3.4	-5.1	-6.8	-8.6	-10.1	-11.5	-12.9	-14.0	-14.6
SERVICES	-2.4	-6.4	-8.9	-12.4	-15.8	-20.2	-25.9	-30.4	-32.7	-32.9	-32.6
PUBLIC ADMIN.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL EMPLOYMENT	-8.1	-20.0	-30.3	-43.4	-57.5	-72.3	-88.2	-101.1	-110.5	-115.6	-118.0

Case 2 High Profits - Low Employment
Ontario Employment
Percent Difference from Base Case Projection

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
AGRICULTURE	-0.2	-0.4	-0.6	-0.8	-1.0	-1.2	-1.4	-1.6	-1.8	-2.0	-2.2
FISH., TRAP.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FORESTRY	-0.2	-0.4	-0.5	-0.8	-1.1	-1.5	-2.0	-2.3	-2.4	-2.6	-2.8
MINING	-0.2	-0.5	-0.6	-0.7	-0.5	-0.5	-0.9	-1.3	-1.5	-1.8	-2.2
FOOD, BEV.	-0.2	-0.4	-0.5	-0.6	-0.7	-0.9	-1.1	-1.2	-1.3	-1.2	-1.3
TOBACCO	-0.4	-1.0	-1.5	-2.1	-2.8	-3.4	-3.9	-4.4	-4.9	-5.3	-5.6
RUBBER, PLAST.	-0.2	-0.5	-0.7	-0.8	-1.0	-1.2	-1.5	-1.7	-1.7	-1.8	-1.9
LEATHER	-0.3	-0.6	-0.8	-1.1	-1.3	-1.6	-1.9	-2.2	-2.3	-2.4	-2.5
TEXTILES	-0.2	-0.6	-0.7	-0.9	-1.1	-1.3	-1.6	-1.8	-1.9	-1.9	-2.0
CLOTHING	-0.2	-0.5	-0.4	-0.4	-0.6	-0.9	-1.0	-1.1	-1.1	-1.2	-1.3
KNITTING	-0.5	-1.4	-1.9	-2.4	-3.2	-3.8	-4.4	-5.1	-5.7	-6.2	-6.6
PAPER	-0.2	-0.5	-0.5	-0.6	-0.7	-0.8	-1.0	-1.1	-1.1	-1.1	-1.1
WOOD	-0.4	-0.7	-0.7	-0.5	-0.3	-0.3	-0.3	-0.2	0.0	0.2	0.3
FURNITURE	-0.2	-0.5	-0.7	-0.9	-1.1	-1.4	-1.7	-1.9	-2.0	-2.1	-2.2
PETROL., COAL	-0.3	-0.7	-0.8	-1.0	-1.2	-1.5	-1.8	-2.0	-2.1	-2.1	-2.3
PRIMARY MET.	-0.2	-0.5	-0.7	-0.8	-0.9	-1.2	-1.5	-1.6	-1.7	-1.8	-1.9
METAL FAB.	-0.2	-0.5	-0.6	-0.8	-0.9	-1.1	-1.4	-1.5	-1.6	-1.6	-1.7
MACHINERY	-0.2	-0.4	-0.5	-0.7	-0.9	-1.1	-1.3	-1.5	-1.5	-1.6	-1.6
ELECTRICAL	-0.2	-0.5	-0.6	-0.8	-0.9	-1.2	-1.5	-1.7	-1.8	-1.8	-1.9
PRINT., PUB.	-0.2	-0.5	-0.6	-0.8	-0.9	-1.1	-1.4	-1.6	-1.7	-1.7	-1.8
NON-MET. MIN.	-0.3	-0.6	-0.8	-1.0	-1.2	-1.4	-1.7	-1.9	-2.0	-2.1	-2.2
CHEMICALS	-0.2	-0.6	-0.7	-0.9	-1.0	-1.2	-1.5	-1.8	-1.8	-1.9	-2.0
TRANS. EQ.	-0.2	-0.4	-0.4	-0.5	-0.6	-0.7	-0.9	-1.0	-1.0	-1.1	-1.1
MISC. MFG.	-0.3	-0.6	-0.8	-1.0	-1.2	-1.4	-1.8	-2.0	-2.2	-2.2	-2.4
MANUFACTURING	-0.2	-0.5	-0.6	-0.7	-0.9	-1.1	-1.3	-1.5	-1.5	-1.6	-1.7
CONSTRUCTION	0.0	0.2	-0.2	-0.7	-1.2	-1.4	-1.6	-1.8	-2.0	-2.0	-1.8
TRANSPORTATION	-0.2	-0.6	-0.8	-1.0	-1.3	-1.7	-2.1	-2.4	-2.6	-2.8	-2.9
COMMUNICATIONS	-0.3	-0.7	-0.9	-1.2	-1.6	-2.0	-2.5	-2.8	-3.1	-3.3	-3.4
STORAGE	-0.2	-0.6	-0.8	-1.0	-1.3	-1.6	-1.9	-2.2	-2.3	-2.3	-2.4
UTILITIES	-0.6	-1.6	-2.4	-3.4	-4.5	-5.2	-5.8	-6.5	-7.7	-8.0	-8.4
TRANS.,COMM., AND UTIL.	-0.3	-0.8	-1.1	-1.4	-1.9	-2.4	-2.8	-3.2	-3.5	-3.8	-4.0
TRADE	-0.2	-0.5	-0.9	-1.4	-1.9	-2.3	-2.6	-2.9	-3.2	-3.3	-3.3
FIN.,INS., AND R.E.	-0.2	-0.7	-1.2	-1.7	-2.2	-2.7	-3.2	-3.5	-3.9	-4.2	-4.3
SERVICES	-0.2	-0.5	-0.6	-0.8	-1.0	-1.3	-1.6	-1.8	-1.9	-1.9	-1.8
PUBLIC ADMIN.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL EMPLOYMENT	-0.2	-0.5	-0.7	-0.9	-1.2	-1.5	-1.8	-2.0	-2.2	-2.2	-2.2

4.6 Case 3 - High Wages - Low Employment

In this projection, workers are extremely concerned about future job losses. They insist on their "normal" real wage increases corresponding to increased productivity, but are also able to obtain a reduction in the average work week on the assumption that this will safeguard the number of remaining future jobs. In the end, unit labour cost increases exhaust the gains from productivity growth.

Our calculations show that with this set of assumptions, real GDP and GNP will be less than 1% higher in 1995 relative to the base case. Employment is lower across the board, again reflecting the absence of any feedback from productivity growth to price competitiveness and extra sales.

Differences in Ontario employment from the base case are provided on the next two pages. The impact on output and employment is essentially the same as in Case 2, except that the expenditure pattern reflects consumer tastes more closely than spending priorities of investors. Consequently, the losses are distributed somewhat differently by industry.

The magnitude of the job losses for a fairly small increase in productivity point out the need to keep wages consistent with full employment.

Case 3 High Wages - Low Employment
Ontario Employment in Thousands
Level Difference from Base Case Projection

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
AGRICULTURE	-0.2	-0.4	-0.6	-0.8	-1.0	-1.2	-1.4	-1.6	-1.8	-2.0	-2.2
FISH., TRAP.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FORESTRY	0.0	-0.1	-0.1	-0.2	-0.2	-0.2	-0.3	-0.3	-0.3	-0.4	-0.4
MINING	-0.2	-0.3	-0.5	-0.7	-0.8	-1.1	-1.4	-1.6	-1.8	-2.1	-2.3
FOOD, BEV.	-0.3	-0.7	-1.0	-1.1	-1.2	-1.5	-1.7	-1.8	-2.0	-2.1	-2.3
TOBACCO	0.0	0.0	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1
RUBBER, PLAST.	-0.2	-0.3	-0.4	-0.5	-0.6	-0.7	-0.8	-0.8	-0.9	-0.9	-1.0
LEATHER	-0.1	-0.1	-0.2	-0.2	-0.2	-0.3	-0.3	-0.3	-0.3	-0.4	-0.4
TEXTILES	-0.1	-0.2	-0.3	-0.4	-0.4	-0.5	-0.6	-0.6	-0.7	-0.7	-0.8
CLOTHING	-0.2	-0.3	-0.4	-0.5	-0.6	-0.7	-0.7	-0.8	-0.9	-1.0	-1.1
KNITTING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PAPER	-0.2	-0.3	-0.5	-0.5	-0.6	-0.7	-0.8	-0.8	-0.9	-0.9	-1.0
WOOD	-0.1	-0.1	-0.2	-0.2	-0.2	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3
FURNITURE	-0.1	-0.2	-0.3	-0.4	-0.4	-0.5	-0.6	-0.6	-0.7	-0.7	-0.8
PETROL., COAL	0.0	-0.1	-0.1	-0.1	-0.2	-0.2	-0.2	-0.2	-0.2	-0.3	-0.3
PRIMARY MET.	-0.2	-0.5	-0.7	-0.8	-0.9	-1.1	-1.2	-1.3	-1.4	-1.5	-1.6
METAL FAB.	-0.3	-0.6	-0.9	-1.0	-1.2	-1.4	-1.6	-1.7	-1.8	-2.0	-2.1
MACHINERY	-0.3	-0.6	-0.8	-0.9	-1.1	-1.2	-1.4	-1.5	-1.6	-1.8	-1.9
ELECTRICAL	-0.3	-0.7	-0.9	-1.1	-1.2	-1.4	-1.6	-1.7	-1.8	-2.0	-2.2
PRINT., PUB.	-0.3	-0.5	-0.8	-0.9	-1.0	-1.2	-1.3	-1.5	-1.6	-1.7	-1.9
NON-MET. MIN.	-0.1	-0.2	-0.3	-0.4	-0.4	-0.5	-0.5	-0.6	-0.6	-0.7	-0.7
CHEMICALS	-0.2	-0.3	-0.5	-0.6	-0.6	-0.7	-0.8	-0.9	-0.9	-1.0	-1.1
TRANS. EQ.	-0.5	-0.9	-1.3	-1.6	-1.9	-2.2	-2.5	-2.7	-3.0	-3.2	-3.5
MISC. MFG.	-0.2	-0.3	-0.4	-0.4	-0.5	-0.5	-0.6	-0.6	-0.7	-0.7	-0.7
MANUFACTURING	-3.5	-7.2	-10.1	-11.7	-13.3	-15.4	-17.4	-19.0	-20.3	-21.9	-23.9
CONSTRUCTION	-0.7	-1.3	-1.8	-2.3	-2.5	-2.7	-3.1	-3.7	-4.5	-5.1	-5.8
TRANSPORTATION	-0.6	-1.2	-1.8	-2.2	-2.6	-3.1	-3.6	-4.0	-4.4	-4.9	-5.4
COMMUNICATIONS	-0.4	-0.7	-1.0	-1.2	-1.4	-1.7	-1.9	-2.0	-2.2	-2.4	-2.5
STORAGE	0.0	0.0	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.2	-0.2
UTILITIES	-0.3	-0.7	-1.0	-1.3	-1.6	-1.8	-2.0	-2.3	-2.7	-3.1	-3.6
TRANS.,COMM., AND UTIL.	-1.3	-2.7	-3.9	-4.8	-5.7	-6.7	-7.6	-8.5	-9.5	-10.6	-11.7
TRADE	-2.6	-5.5	-7.9	-9.6	-10.9	-12.3	-13.7	-15.3	-17.3	-19.1	-20.7
FIN.,INS., AND R.E.	-1.5	-3.3	-4.8	-6.0	-7.1	-8.3	-9.2	-10.2	-11.3	-12.4	-13.3
SERVICES	-4.4	-8.9	-13.1	-15.8	-18.2	-21.1	-24.3	-27.8	-31.0	-34.0	-37.8
PUBLIC ADMIN.	-0.3	-0.6	-0.7	-0.4	-0.1	-0.1	0.0	0.3	0.6	0.8	0.9
TOTAL EMPLOYMENT	-14.8	-30.4	-43.5	-52.1	-59.8	-69.1	-78.3	-87.7	-97.2	-106.8	-117.2

Case 3 High Wages - Low Employment
Ontario Employment
Percent Difference from Base Case Projection

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
AGRICULTURE	-0.1	-0.3	-0.4	-0.6	-0.7	-0.9	-1.0	-1.2	-1.3	-1.5	-1.6
FISH., TRAP.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FORESTRY	-0.4	-0.8	-1.1	-1.3	-1.5	-1.8	-2.1	-2.4	-2.6	-2.8	-3.1
MINING	-0.5	-1.0	-1.6	-2.0	-2.4	-3.0	-3.7	-4.3	-4.9	-5.4	-6.0
FOOD, BEV.	-0.3	-0.7	-1.0	-1.1	-1.2	-1.3	-1.5	-1.6	-1.7	-1.9	-2.0
TOBACCO	-0.4	-1.0	-1.3	-1.5	-1.7	-1.9	-2.1	-2.2	-2.4	-2.5	-2.7
RUBBER, PLAST.	-0.4	-0.7	-1.0	-1.1	-1.2	-1.4	-1.6	-1.7	-1.8	-1.9	-2.1
LEATHER	-0.4	-0.8	-1.1	-1.2	-1.4	-1.5	-1.7	-1.8	-1.9	-2.1	-2.2
TEXTILES	-0.4	-0.8	-1.0	-1.2	-1.3	-1.5	-1.6	-1.8	-1.9	-2.0	-2.2
CLOTHING	-0.4	-0.9	-1.1	-1.2	-1.4	-1.7	-1.8	-2.0	-2.1	-2.3	-2.6
KNITTING	-0.3	-0.6	-0.6	-0.4	-0.2	0.0	0.3	0.8	1.1	1.2	1.2
PAPER	-0.3	-0.7	-0.9	-1.0	-1.1	-1.3	-1.4	-1.5	-1.6	-1.7	-1.8
WOOD	-0.3	-0.7	-0.9	-0.9	-1.0	-1.1	-1.2	-1.2	-1.2	-1.3	-1.4
FURNITURE	-0.4	-0.7	-1.0	-1.2	-1.3	-1.5	-1.6	-1.8	-1.9	-2.0	-2.2
PETROL., COAL	-0.4	-0.8	-1.1	-1.3	-1.4	-1.6	-1.8	-1.9	-2.0	-2.2	-2.3
PRIMARY MET.	-0.4	-0.7	-1.0	-1.1	-1.3	-1.4	-1.6	-1.8	-1.9	-2.0	-2.2
METAL FAB.	-0.4	-0.7	-1.0	-1.1	-1.2	-1.4	-1.6	-1.7	-1.8	-1.9	-2.1
MACHINERY	-0.4	-0.8	-1.1	-1.3	-1.4	-1.6	-1.8	-1.9	-2.1	-2.2	-2.4
ELECTRICAL	-0.3	-0.7	-1.0	-1.1	-1.2	-1.4	-1.5	-1.6	-1.8	-1.9	-2.1
PRINT., PUB.	-0.4	-0.7	-1.0	-1.1	-1.2	-1.4	-1.6	-1.7	-1.8	-2.0	-2.1
NON-MET. MIN.	-0.4	-0.8	-1.1	-1.2	-1.4	-1.5	-1.7	-1.9	-2.0	-2.1	-2.3
CHEMICALS	-0.3	-0.7	-1.0	-1.1	-1.2	-1.4	-1.6	-1.7	-1.8	-1.9	-2.1
TRANS. EQ.	-0.3	-0.7	-0.9	-1.1	-1.2	-1.4	-1.6	-1.7	-1.9	-2.0	-2.2
MISC. MFG.	-0.4	-0.7	-0.9	-1.0	-1.0	-1.2	-1.3	-1.3	-1.4	-1.4	-1.5
MANUFACTURING	-0.4	-0.7	-1.0	-1.1	-1.2	-1.4	-1.6	-1.7	-1.8	-1.9	-2.1
CONSTRUCTION	-0.3	-0.6	-0.8	-0.9	-1.0	-1.1	-1.2	-1.4	-1.7	-2.0	-2.2
TRANSPORTATION	-0.4	-0.8	-1.1	-1.3	-1.5	-1.8	-2.0	-2.2	-2.4	-2.6	-2.9
COMMUNICATIONS	-0.4	-0.7	-1.0	-1.2	-1.3	-1.6	-1.7	-1.8	-2.0	-2.1	-2.2
STORAGE	-0.4	-0.7	-1.1	-1.2	-1.4	-1.6	-1.8	-1.9	-2.0	-2.2	-2.3
UTILITIES	-0.7	-1.4	-2.1	-2.6	-3.1	-3.4	-3.6	-4.0	-4.8	-5.1	-5.5
TRANS.,COMM., AND UTIL.	-0.4	-0.9	-1.2	-1.5	-1.7	-1.9	-2.1	-2.4	-2.6	-2.9	-3.1
TRADE	-0.4	-0.8	-1.1	-1.3	-1.4	-1.6	-1.7	-1.9	-2.1	-2.3	-2.4
FIN.,INS., AND R.E.	-0.5	-1.2	-1.7	-2.0	-2.3	-2.6	-2.9	-3.1	-3.4	-3.7	-3.9
SERVICES	-0.3	-0.6	-0.9	-1.1	-1.2	-1.3	-1.5	-1.7	-1.8	-1.9	-2.1
PUBLIC ADMIN.	-0.1	-0.2	-0.2	-0.1	0.0	0.0	0.0	0.1	0.2	0.2	0.3
TOTAL EMPLOYMENT	-0.3	-0.7	-1.0	-1.1	-1.3	-1.4	-1.6	-1.7	-1.9	-2.0	-2.2

5. CONCLUSION

Economic projections for the next ten years generally call for modest increases in real GNP of 2.5-3% per year, annual productivity growth of about 1%, and a slow decline in the unemployment rate from 11% now to about 6% by 1995. If productivity could be increased an extra 5% over the next ten years, real GNP could be 5% higher, and unemployment could be reduced faster, provided that prices and wages respond in a reasonably competitive manner. If the gains from productivity growth are instead used to increase profit margins, unemployment could stay at 8% or more. A similar result is likely if most of the benefits go into real wage increases.

The pessimistic scenarios (Cases 2 and 3) are in our view not the most likely. After about 10 years of attempts to push through price and wage increases inconsistent with domestic and foreign productivity, we seem to have returned to a business environment in which cost competitiveness takes center stage. Likewise, unions seem to be more willing to accept that bargaining should be based on the financial performance of the employer and international competitiveness rather than on the Consumer Price Index, which bears little relation to the ability to generate the sales to cover increased wages.

Positive signals that the economy continues to evolve in a manner consistent with the faster growth scenario outlined above would include:

1. Stability in the share of wages in GNP at around 55%. Attempts to go much higher imply an unattractive return to investment, and reduced ability to let productivity be reflected in prices.

2. An average rate of wage increase below the rate of CPI inflation while unemployment remains high.

3. Increased acceptance of new technology coupled with a willingness on the part of firms to assist in retraining of employees.

Danger signals pointing to imbalances include the following:

1. A large number of workers laid off, over an extended period, in an industry paying above-average hourly wages.

2. A high profit margin in an industry protected from international competition.

SECTION III

STUDIES OF THE OVERALL ECONOMY: A COMMENT

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STUDIES IN THE OVERALL ECONOMY: A COMMENT

- Sam Gindin, UAW

1. INTRODUCTION

Appendix 20 of the report of the Ontario Task Force on Technology and Employment includes two papers dealing with the relationship between employment and a number of macroeconomic variables. One of these variables is the distribution of income shares between wages and profits, and the conclusion drawn is that, other things equal, higher real wages mean more unemployment. Conversely, a decline in real wages leads to more jobs. This point is common to econometric models; the following comment from one of the papers in this appendix is typical amongst mainstream economists:

> " .. Wage settlements have come down, but there is still understandable resistance to settle for wage increases below the rate of inflation. This is making it difficult to increase employment fast enough to reduce the unemployment rate quickly."
>
> - Leo de Bever, Chase Econometrics Canada.

The obvious implication of this conclusion would seem to be that wage restraint and wage concessions are central to a full employment strategy. In this paper, I want to challenge the validity of both the conclusion and this particular implication.

To start, it must be pointed out the relationship between lower real wages and job creation is not really a "conclusion" that pops out of the model. It is built into the model as an assumption of how the economy works. What the model does is the number crunching to measure the size of the assumed relationship.

Furthermore, even if the relationship were true - that, other things equal, more jobs require more of society's income going to corporations and less to workers - the implication is not necessarily to challenge the level of real wages. An alternative implication is that improved income distribution and lower unemployment are incompatible with our present economic structures (those "other things equal"), and

that it is these taken-for-granted economic structures that must be changed (eg. free markets, corporate rights). In other words, the same "conclusion" might very well imply challenging the power of corporations, rather than the wage-influencing power of workers.

2. REAL WAGES AND JOBS: THE IMMEDIATE PAST

The suspicion that workers have about the relationship between real wages and jobs goes beyond their understandable interest in increasing their standard of living. It is also based on immediate past experience.

Over the past decade, real wages have not increased in spite of the adoption of significant levels of new technology (real wages in manufacturing remain below their levels in 1976). Public policy, responding to this assumed relationship between real wages and jobs, was one of the reasons for this stagnation; the other was the depth and length of the recession.

Yet workers saw no predicted decline in unemployment. In fact, unemployment rose steadily through the period of government-mandated wage controls in the latter seventies, and again during the removal of collective bargaining rights in public sector jurisdictions in the early eighties. In specific sectors where the restraint argument has had the highest profile - like the U.S. auto industry - the wage restraint has been matched by a continuing outflow of jobs, slowed down only by political pressures.

To explain the dramatically-failed predictions of their models over this important period, economists argue that the problem was not their models, but the coming on the scene of "external" factors such as the second energy crisis, the rapid emergence of competitors outside of N. America, and U.S. economic policy with regards to their deficit and its impact on interest rates and exchange rates.

Technically, this defense may be valid. But it does, to put it mildly, force us to be very cautious in interpreting results when the most important factors may very well continue to remain outside the model.

3. THE MODEL AND ITS ASSUMPTIONS:

Let's consider the assumptions that lead to the stated conclusion. These assumptions are incorporated into a theoretical model which, briefly, postulates the following economic relationship as a cornerstone:

a) As real wages rise, the labour input becomes relatively more expensive than other inputs and corporations respond by increasing the rate at which they substitute capital for labour. While this may not happen immediately, it will over time mean less labour than would otherwise have been the case.

b) These higher real wages translate into higher prices and, at higher prices, demand for the product (domestic and international) falls, meaning less volume and therefore fewer jobs.

c) Although wages are not just a cost, but income, and higher income (wages) should stimulate job creation, this is offset by two factors: much of Canadian demand is in fact imported and so it doesn't create Canadian jobs; and there are far larger potentials in international markets - potentials which higher wages (prices) will diminish.

A number of credible points can be made to question and/or counter the implicit assumptions of this model:

i) Consider the assumption that higher wages make the use of labour-replacing capital more attractive and therefore cost jobs. Neo-classical economics may present this as an obvious "truth", but daily and historical experience indicate a quite different relationship.

For example, most analysts will identify one of the key strengths of the Japanese auto industry as being its rapid introduction of new technology in the form of robots. And so we have Japan, contrary to the economic theory of this model, having both lower wages (labour compensation in Japan is less than two-thirds the U.S. level and about 15% below Canada) and not less, but more rapid replacement of workers with capital.

Furthermore, even if more labour and less capital may seem more efficient with more job potential if we limit ourselves to a snapshot in time, the historical record shows that higher wages pushed companies into introducing more capital, embodying new technology, in order to compete, and this has meant higher industrial productivity and more jobs - as the economic models themselves show.

Put simply, this particular assumption in the model is static and misses the dynamics of industrial development.

ii) This model takes the input of workers as a given, but the quality of labour can't be separated from its compensation. On the one hand, companies are increasingly emphasizing the need to have more committed workers and to better tap into the workers' skills, knowledge, and experience to improve quality and productivity. On the other hand, some companies are trying to simultaneously restrain wages.

The point is that an attempt to cut back on wages in the name of competitiveness may backfire because of its negative impact on workers' attitude to their work and therefore on their own input.

iii) This model assumes that marginal improvements in competitiveness will have a significant impact. But in today's world, any practical level of restraint in wages will not in fact make us that much more competitive. In some cases, this is because the remaining wage gaps with emerging competitors will still be vast (we cannot, nor should we want to, match their standard of living). In other cases, wage restraint has little competitive impact because it is swamped by other much more important factors (exchange rates, structural factors such as an inadequate technological base in Canada at all levels: research, development, engineering, and manufacturing).

Wage restraint will, therefore, not significantly strengthen our penetration of foreign markets and so there will be little positive impact on these jobs. But it will, because workers have less to spend, decrease domestic demand and its related jobs. In these circumstances, a policy geared to stimulating domestic demand (including higher wages) and guaranteeing a secure share for Canadian producers in this demand (eg. through "Canadian content" legislation), would do more for job creation than that of income restraint. Amongst other things, it might increase corporate investment and therefore jobs in Canada since a guaranteed stable market would be the incentive.

iv) Related to the above, this model requires flexible (lower) corporate pricing to reach its conclusion - otherwise the wage restraint simply translates into higher corporate profits and stockholder returns, rather than jobs. If this price flexibility is achieved through an anti-combines policy, then, as a number of people have warned, this may have the negative consequence of preventing the development of world-scale competitors. If the price

flexibility is achieved through opening up our markets even more, then, as we pointed out earlier, the realities of today may mean even more imports and fewer jobs.

v) The model, in assuming "other things equal", does not allow for the implications of all countries trying to solve their job problems by keeping their own wages and incomes down. With labour income and demand falling everywhere, who will buy the goods?

A policy which might make sense in one country is neutralized as wage restraint in one country is simply matched in other countries. And as trading partners follow a parallel direction, this essentially "beggar-my-neighbour" policy becomes dangerous in terms of the possibility of a severe international recession.

vi) Finally, it should be noted that econometric models generally have a built-in bias for optimism because of their assumptions that the economy tends towards equilibrium. What the models do is provide some insights about the path towards a lower-unemployment equilibrium, and so they focus attention on how we can adapt to the changes which are occuring.

The question of whether the economy will in fact move towards an equilibrium in the context of rapid technological change and accelerated international competition is not one that the model asks since it is essentially assumed away. Answering this question requires research beyond such models (research which the Task Force addressed through its 23 case studies).

4. CONCLUSION:

Econometrics models can be useful or dangerous depending on how cautious we are about what they are in fact saying and what the true implications are. One of the issues dealt with in this particular model was the relationship between income distribution and jobs. This is a valid and important question but, unfortunately, the model assumes that higher real wages will (other things equal) have a negative impact on jobs. I have argued that the relationship is at least problematic - it cannot be assumed nor asserted as if it is obvious and common sense.

The theoretical and empirical case has not been established that wage restraint will provide jobs. At some point, it may of course be valid that continued growth in wages and attempts to change the distribution of income in favour of labour may prevent an economy such as ours from functioning, since such an economy remains based on profits and market competition. But there is no evidence that workers have close to this kind of power today.

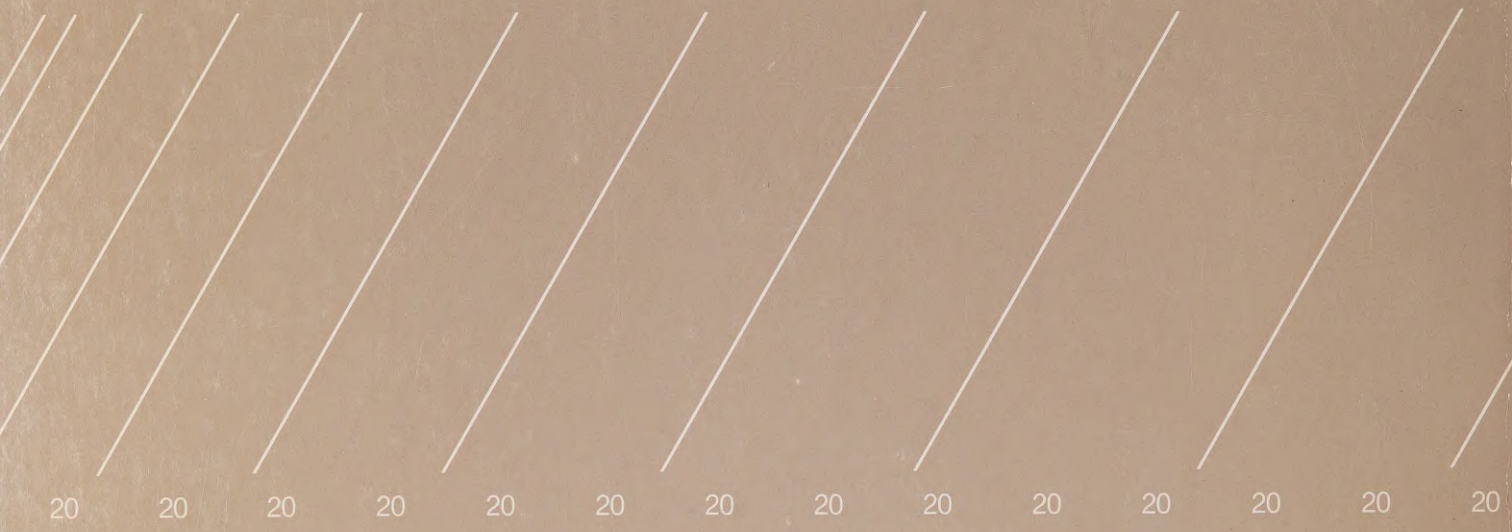
And if and when that does occur, the question cannot be posed simply in terms of taking the status quo of our economic structure for granted, and choosing between income distribution goals and jobs. An alternative question, that goes beyond the inherent limits of the econometric studies, is whether existing economic structures can themselves be changed (eg. through public control and planning) to make possible both job creation and improved income distribution.

FINAL REPORT AND APPENDICES OF THE ONTARIO TASK FORCE ON EMPLOYMENT AND NEW TECHNOLOGY

Final Report: **Employment and New Technology**

Appendices:

1. Labour Market Trends in Ontario, 1950-1980
2. Occupational Employment Trends in Ontario, 1971-1981
3. Emerging New Technology, 1985-1995: Framework for a Survey of Firms
4. Employment and New Technology in Ontario's Manufacturing Sector: A Summary of Selected Industries
5. Employment and New Technology in the Iron and Steel Industry
6. Employment and New Technology in the Metal Fabricating Industry
7. Employment and New Technology in the Machinery and Equipment Industry
8. Employment and New Technology in the Aircraft and Aircraft Parts Industry
9. Employment and New Technology in the Communications Equipment Industry
10. Employment and New Technology in the Office, Store and Business Machine Industry
11. Employment and New Technology in the Plastic Processing Industry
12. Employment and New Technology in Ontario's Service Sector: A Summary of Selected Industries
13. Employment and New Technology in the Chartered Banks and Trust Industry
14. Employment and New Technology in the Insurance Industry
15. Employment and New Technology in the Government Services Industry
16. Employment and New Technology in the Telecommunications Industry
17. Employment and New Technology in the Retail Trade Industry
18. Employment and New Technology in the Computer Services and Management Consulting Industry
19. Industry-Sector and Occupational Employment in Ontario, 1985-1995
20. Technological Change, Productivity, and Employment: Studies of the Overall Economy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